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World

September 1981 75p

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Cromemco System Three



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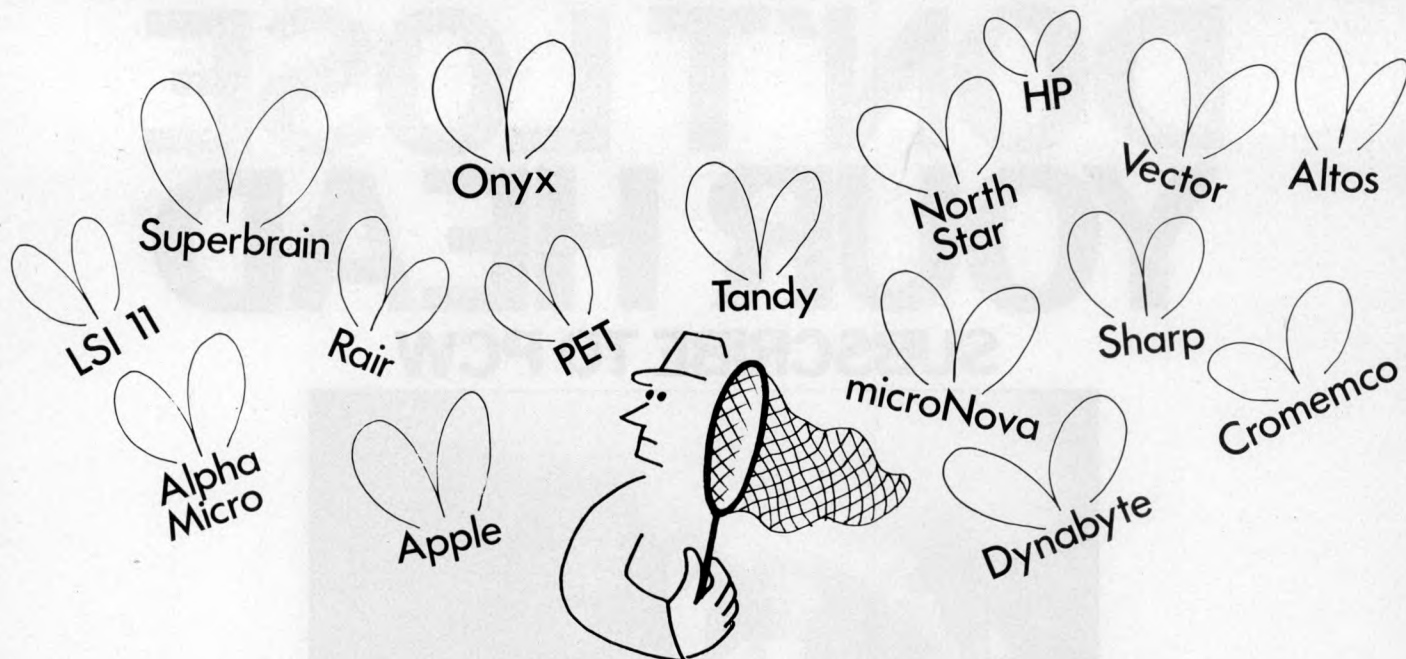
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PCW 1



If only choosing a microcomputer was as simple as using one

Just look at the advertisements in this magazine. When can you find time to digest them all?

There are millions of chips, thousands of boards and hundreds of peripherals, software systems and application packages. How do you pick the right ones to meet your requirements?

And put them together? And make them work? And add the specials you want?

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This year we can put over 200 man years computer experience to work so that you can benefit from micro technology... in comfort.

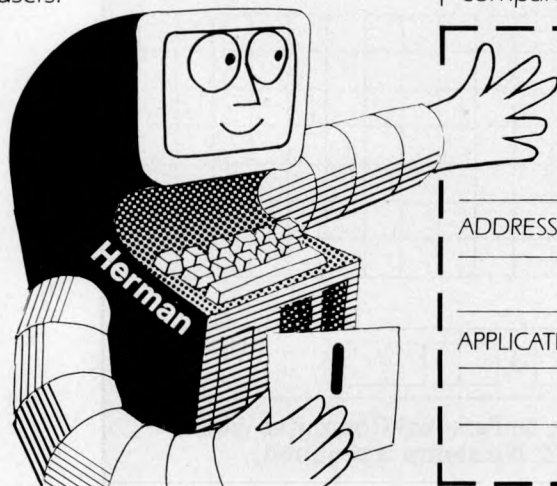
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APPLICATION _____

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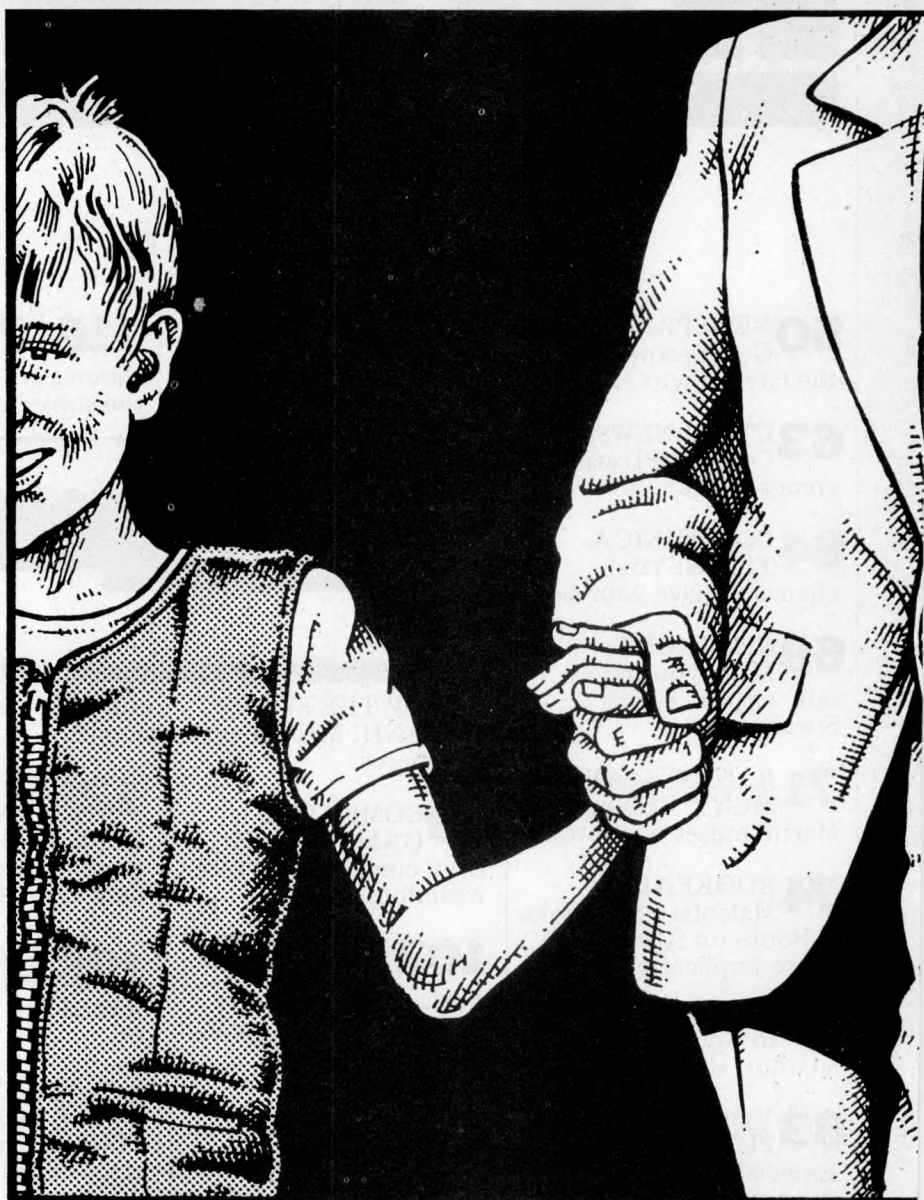
MIXING BUSINESS

This year, the *Personal Computer World Show* will be twice the size of last year's event. Almost every big name (and a lot of smaller ones) in the micro-electronics industry will be represented somewhere in our new style exhibition. (Elsewhere in this issue of *PCW* you will find a complete list of companies and organisations participating). And many of the products will be on display for the first time in this country.

We've divided the Show into two broad areas of interest. A massive array of business and professional applications upstairs and a mouth-watering range of hobbyist orientated products downstairs. Downstairs, too, you'll be able to watch a battle of electronic wits in the 2nd European Microcomputer Chess Championship or talk to any one of the many representatives from computer societies and the ComputerTown UK! network.

Whatever you're looking for in the microcomputing field, or even if you're not certain what you *should* be looking for, you'll find it at *The 4th Personal Computer World Show*. You don't have to leave your spouse or the kids behind, either. We have designed the Show deliberately to cater for the widest possible spectrum of visitors. And children under eight years old will be admitted free.

Now, who says you can't mix business with pleasure?



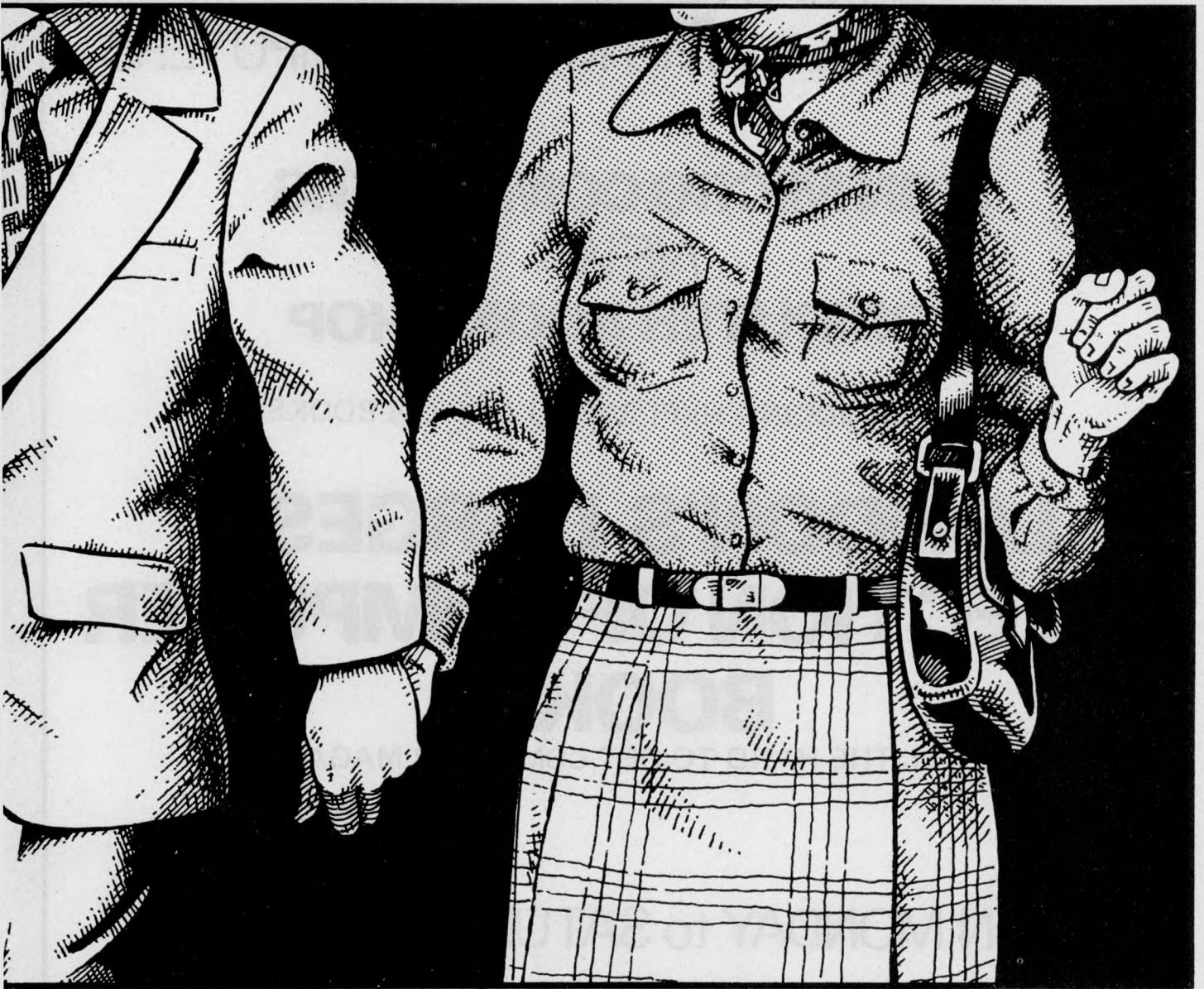
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**Cunard Hotel
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**10-12 September
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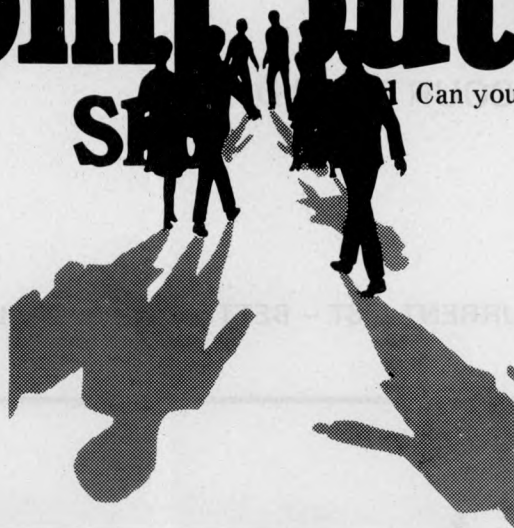


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NEW TANTEL £170

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New Tanel is a Prestel adaptor in its own right. Connect it to a Post Office jack and the aerial socket of your TV and it's ready to use. But the real flexibility begins to show when you interface to your computer. Not only do you have access to 180,000 pages of information, but you can use new Tanel as a COLOUR GRAPHICS terminal for your computer using the PRESTEL STANDARD character set of 40 characters by 24 lines, and you can define the colour of each

symbol individually, with or without flashing. Scrolling is software selectable as is a cursor.

New Tanel talks to your computer at 1300 Baud CUTS standard through its cassette interface. You can of course use your computers' ASCII Keyboard to send messages or letters through New Tanel to the Prestel computer, thus extending the facilities of the Tanel unit.

The price is £170 plus VAT – no more expensive than the original Tantel

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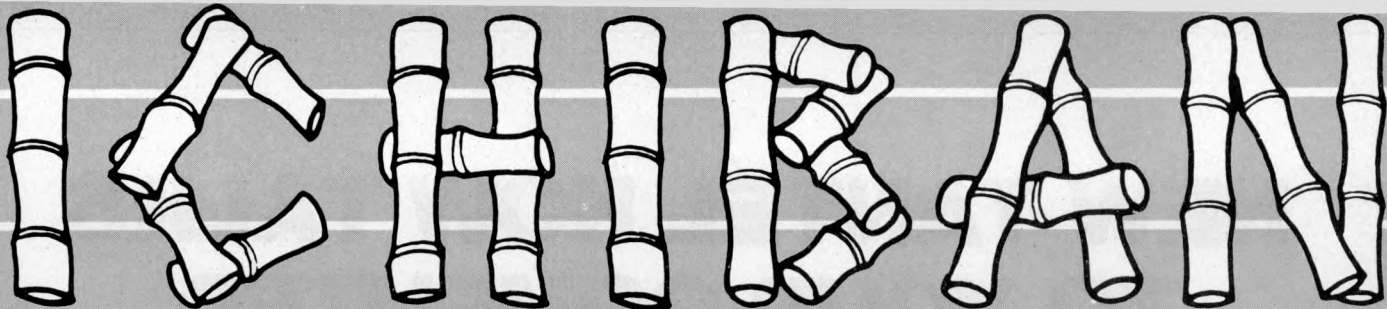
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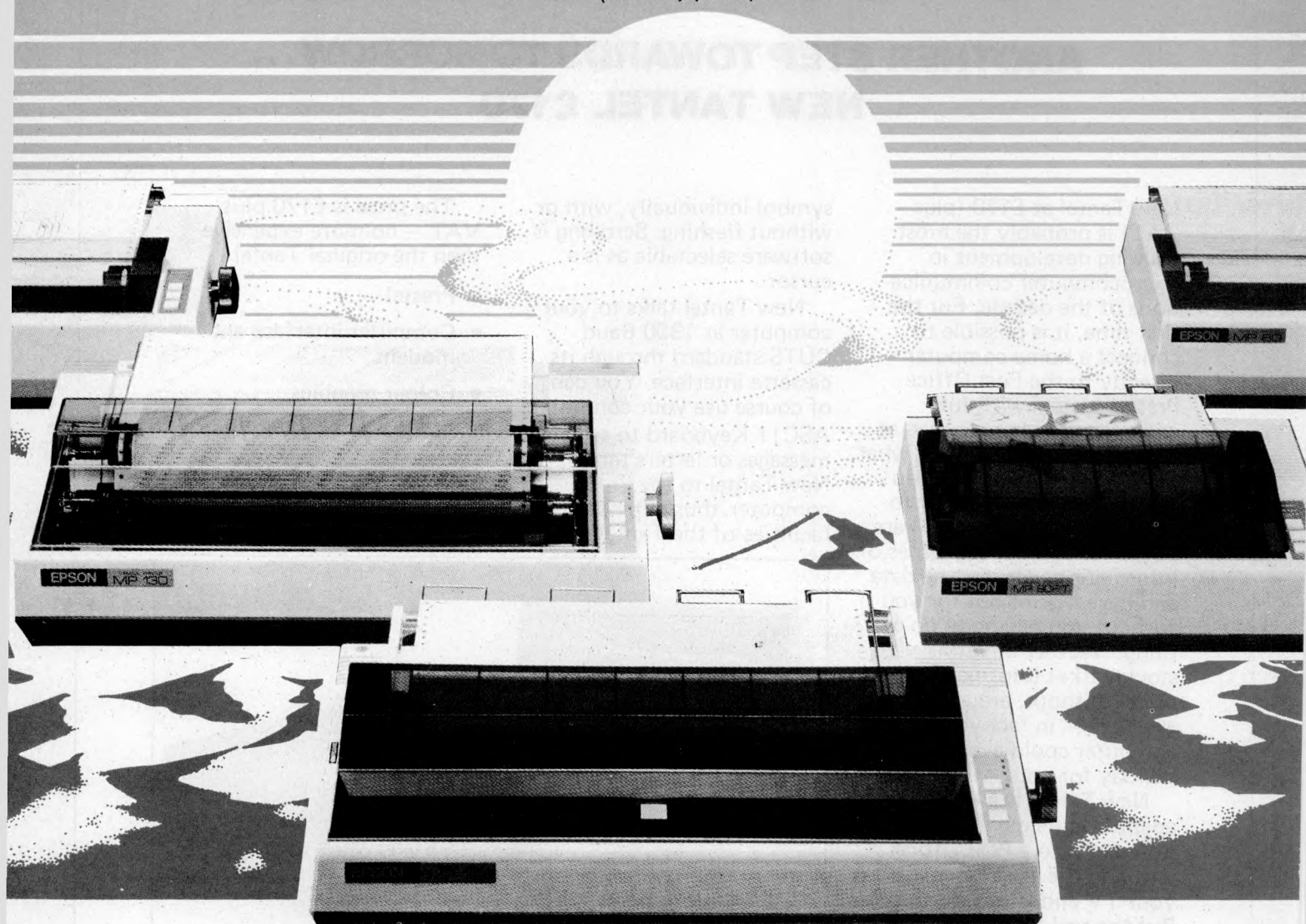
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These prices do not include VAT & delivery

The above machines have many more features including interfaces for Apple, PET (with PET Graphics), TRS80, Sharp, NEC, Hitachi, Nascom, Acorn, BBC Micro etc, some have correspondence quality printing and multiple character sets including international languages. Ring lan today for full details and specifications and printout samples. All machines usually ex-stock with next day delivery plus 12 month no-quibble guarantee.

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In September 1981 the new BBC Microcomputer* goes into production. It will be available by mail-order from the end of October. We believe that this computer will far out-perform any other

- Full QWERTY keyboard with full cursor controls and 10 user programmable keys. Sealed contact switch construction tested to a minimum of 3,000,000 operations.
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- RAM expandable to 32K bytes.
- ROM expandable to 48K bytes.
- Second 8-bit processor option with up to a total of 96K RAM.
- 16-bit processor expansion with up to 8 Megabytes of RAM.
- Cassette and disk interface and filing system.
- Teletext and Prestel (Viewdata) interfaces.
- Networking facility (Econet).
- RS232 Interface.
- Centronics printer interface.
- Analogue to Digital Interface (Paddle or joystick).
- Built-in loudspeaker and sound generator.
- Voice synthesiser.
- Elapsed time clock.

A full range of peripherals including printers, disks, monitors will be available for business use.

Regional advice centres for educationalists and user groups for hobbyists are being established.

Nationwide servicing facilities.

machine at a remotely comparable price. We have listed below some of the many features, and suggest that they are considered by anyone choosing a computer for home, school or business use.

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Memory mapped, transparent access with eight formats:

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20 x 32 text | (20K) |
| 4. 80 x 25-2 colour text | (16K) |
| 5. 320 x 256-2 colour graphics and
40 x 32 text | (10K) |
| 6. 160 x 256-4 colour graphics and
20 x 32 text | (10K) |
| 7. 40 x 25-2 colour text | (8K) |
| 8. 40 x 25 teletext compatible | (1K) |

Operates in a microsoft-type basic extended to provide unrestricted variable names; multi-line statements, functions and procedures with local variables; powerful string handling; built-in mnemonic assembler and features for structured programming.

Pascal in ROM available as a second language.

This computer system has been developed as part of the computer literacy project to be launched on BBC 1 in January 1982. The project also includes a 10-part television series, a book, a 30-hour course in programming in BASIC and a range of applications software.

Secondary schools buying this computer may qualify for the 50% DOI grant.

For more details of the BBC Microcomputer System just fill in the coupon below and send it to:
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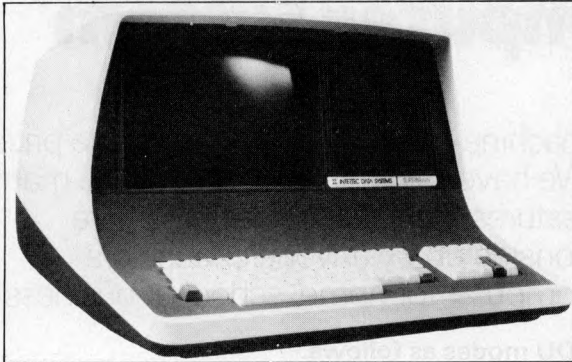
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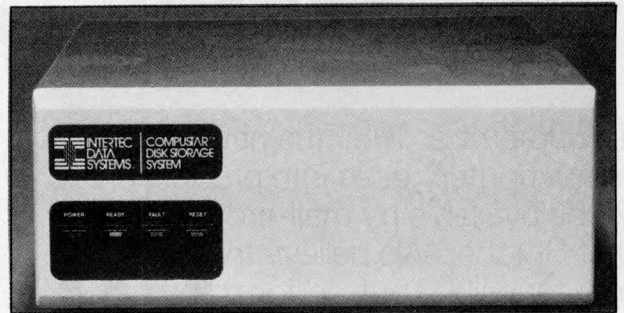


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350K or 700K of Disk Storage

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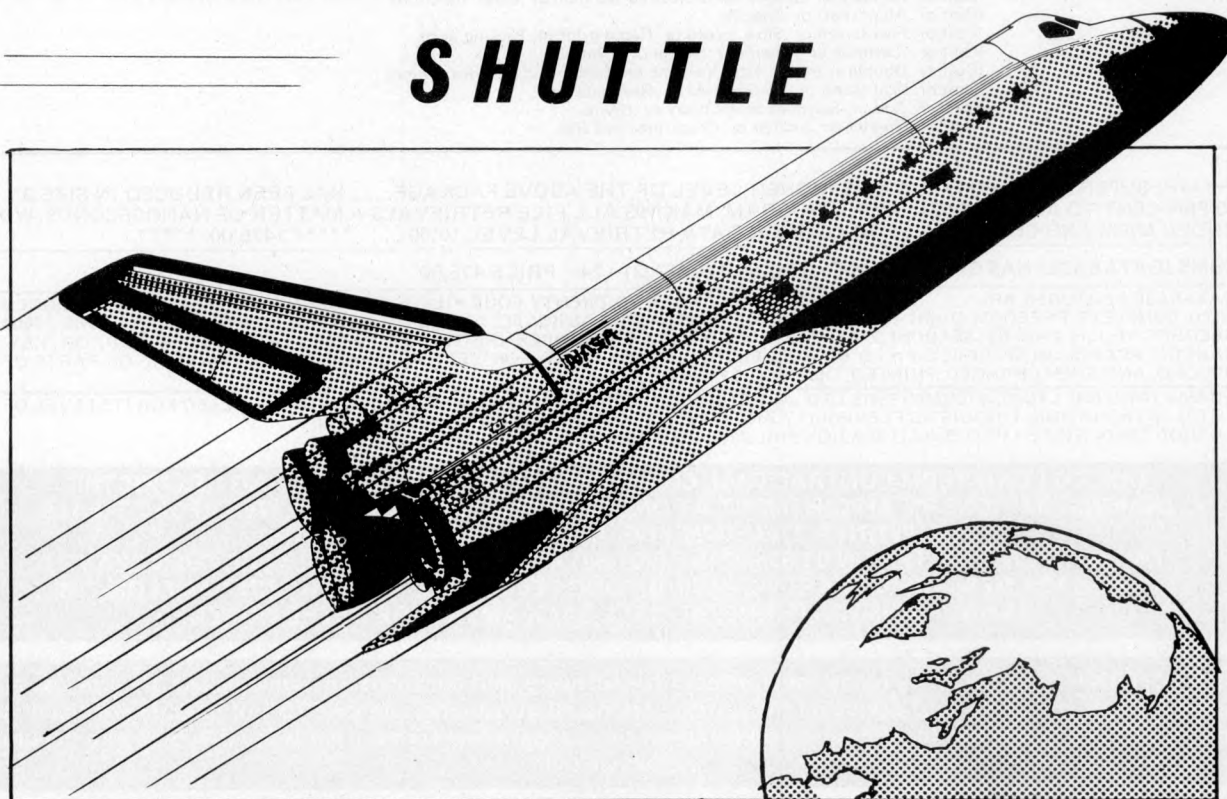
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This program is a highly accurate computer simulation of the flight of the Space Shuttle Columbia from the initial countdown through the launch period, the launch itself and into a stable orbit. The craft may be manoeuvred within the orbit and then dropped out to finally fly through the atmosphere to a safe touchdown.

The attraction of this simulation is its authenticity. So far as is possible, it follows the actual parameters of the first Columbia flight with only one or two minor exceptions. The shuttle, of course, starts its flight pointed vertically into the sky and carries a huge fuel tank to provide the fuel for its three main engines in addition to the solid fuel rockets which provide the major thrust to lift it off the ground. Two minutes into the flight the rockets are jettisoned, having burned all their fuel. The count-down for take off starts at T-20 seconds. At T-10 seconds the shuttle motors start firing, but the shuttle remains tethered until T=0. When the shuttle blasts off, the pilot must guide the craft into its orbit by controlling its attitude and track. A number of guidance controls are supplied, together, of course, with control of the shuttle motors' thrust.

The simulation may be started at one of three points in time: either at take off, at a point where the Columbia is in a stable orbit round the earth, or finally, prior to landing. Measurements of speed, fuel and so on may be selected for either Metric or Imperial measurements. All of the physical forces which acted upon the actual flight are taken into account. One departure from fact has been included in that the two solid fuel rockets have had their thrusts increased from 26 to 36 million Newtons so as to give the pilot an increased latitude for error. In other words to make the take off easier.

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LDOS

First there were the TRSDOS's, 2.0, 2.1, 2.2 and 2.3. Then came Newdos +, essentially a patched version of the TRSDOS's but with a number of very useful commands and utilities added. Then VTOS 3.0 and VTOS 4.0. These constituted a departure from the earlier DOS's and featured Device Independence so that devices such as the keyboard, printer, VDU and disk drives could interact directly together. Then came Newdos80 which is a rewrite of Newdos +, adding new utilities and new Basic commands, its main features being the ability to mix different capacity drives on the same cable and the ability to use variable length records. Now from LOBO International comes LDOS, the fifth generation disk operating system for the TRS-80 microcomputer. It combines most of the advantages of the preceding disk operating systems and unlike some of them, is accompanied by a complete and readable set of documentation, which includes a Technical Section containing relevant addresses.

It is impossible to describe all of the features of LDOS in an advertisement. For instance it includes no less than 35 library commands as follows:—

APPEND	COPY	DEVICE	DIR	DO	FILTER	KILL
LIB	LINK	LIST	LOAD	MEMORY	RENAME	RESET
ROUTE	RUN	SET	SPOOL	ATTRIB	AUTO	BOOT
BUILD	CLOCK	CREATE	DATE	DEBUG	DUMP	FREE
PROT	PURGE	SYSTEM	TIME	TRACE	VERIFY	XFER

All of the useful abbreviations in Newdos are included and the System Commands in Basic (CMD) now number eleven. A program called LBASIC/FIX is included, with which the normal TRSDOS Disk Basic may be patched to include a number of new commands and features. A Job Control Language is included and in fact is one of the most powerful features of LDOS. It allows the user to compile a sequence of commands or key strokes for later execution as a chain, with or without user intervention. There are too many new features to list them herein, but examples are: The ability to provide an audible signal, output through the cassette port. To flash or blink a one line message on the video display. A WAIT feature is included so that the machine can be put into a "sleep" state until such time as the system clock matches the time specified. And so on!

Hard disks in addition to single/double density, single/double sided, 8" and 5 1/4" floppies are supported although they may, of course, require hardware modifications. Utilities included in the package are:

BACKUP	COMMAND FILE	FORMAT	LCOMM
PATCH	RS232	KEY STROKE/MULTIPLIER	PRINTER FILTER

A Basic Renumber facility is included, as is a Basic Cross Reference function. Both are similar to the ones in Newdos + and Newdos80. Most of the utilities are library commands which were existent in the previous DOS's, have been improved with the addition of new functions or facilities.

The prime development team of LDOS consisted of no less than 8 first rank programmers and they had the support and advice of six other well known programmers. They have done an excellent job to bring to the user what must be the best disk operating system so far produced for a microcomputer, which is destined to become the Standard DOS.

LDOS is totally upward compatible with TRSDOS, that is to say LDOS will be able to copy files and programs from TRSDOS disks onto LDOS formatted disks. As they are competitive disk operating systems, it is not surprising that the manual states that disks created under Newdos are not guaranteed to be compatible with LDOS, but we have not experienced any difficulty. We have done some work on investigating the compatibility of LDOS and the Video Genie and at the time of going to press we have found no incompatibilities. LDOS appears to run on the Video Genie without any problems at all. LDOS is compatible with either the Tandy or Electric Pencil lowercase modifications and Scripsit. LDOS is available for the Model I and Model III. A Model II version will be available shortly.

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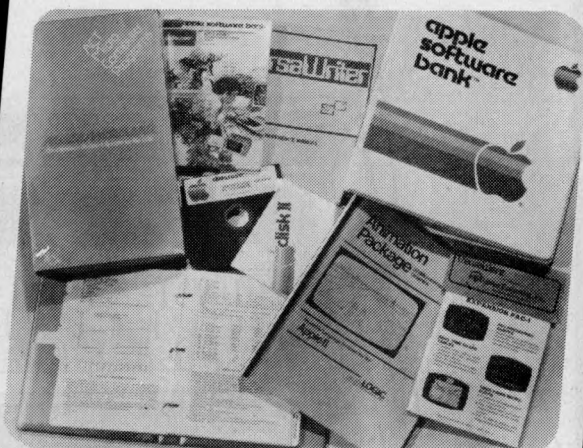
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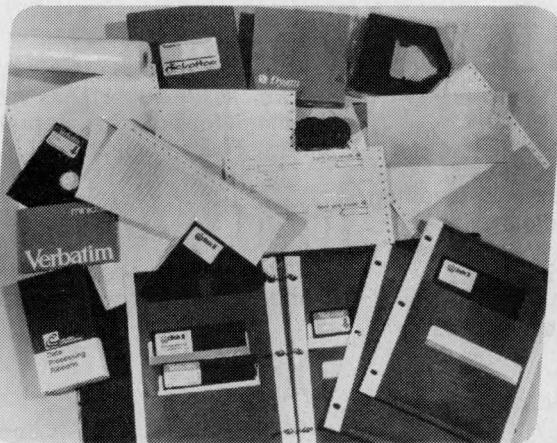
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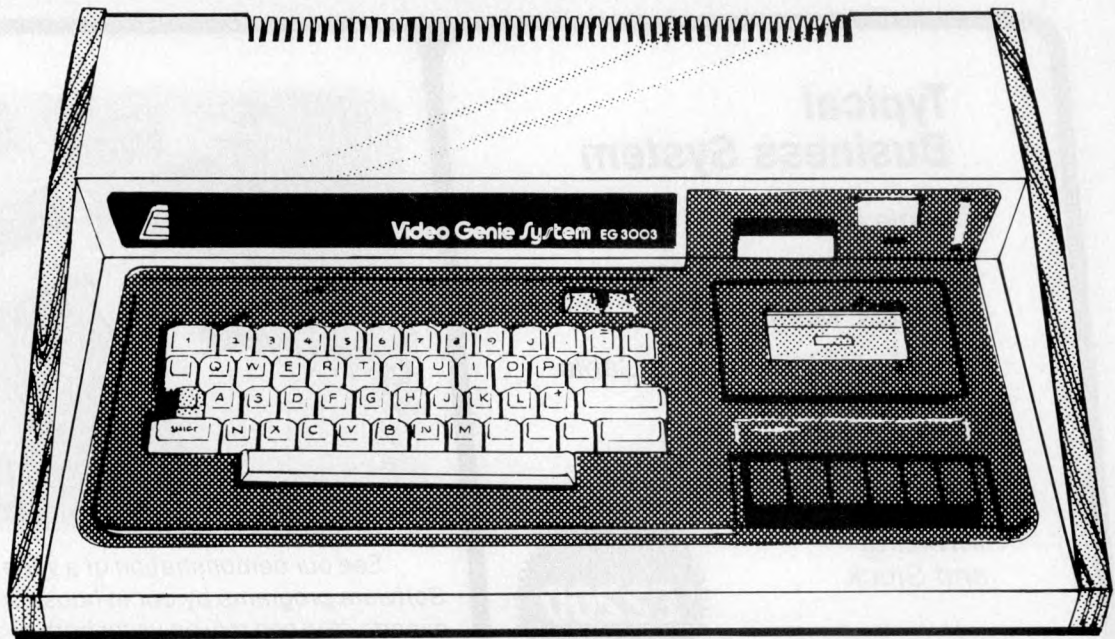
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64 or 32 characters $\times$ 16 lines are available on the full display.

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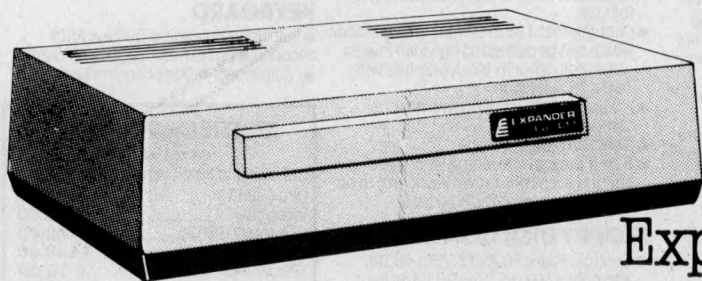
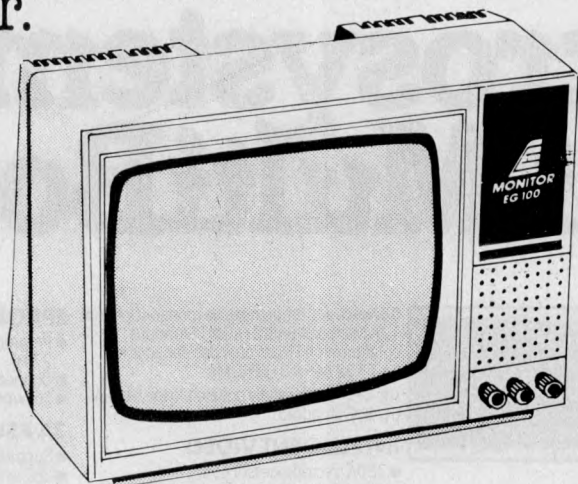
electronics

one giant step for micro-computer systems

12" Monitor.

The additional purchase of the EG 100 Monitor offers 3 distinct advantages

- It gives a considerably better quality display.
- It does not interfere with domestic T.V. viewing.
- It comes in an attractive, matching style.



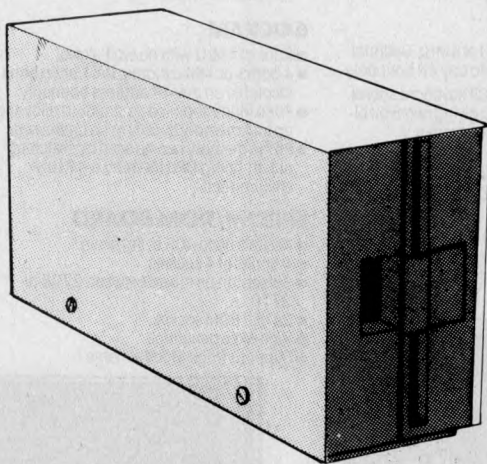
Expander.

The expansion box unleashes the full possibilities of the Genie. It

contains a selection of interfaces, allowing the connection of up to 48K RAM, 4 disk drives, printers and S100 cards.

Disk Drive.

As well as the obvious advantage of mass-storage, the addition of the disk system to the Genie means much faster access to other languages and full random access file handling. Up to 4 drives can be used on a system.



For full details and demonstrations of the Video Genie system (EG 3003), contact your local dealer, or write directly to the sole importers at the address below.

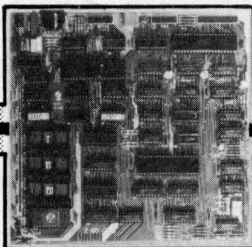
Video Genie Approved Dealers

AVON Microstyle, Bath, 0225 334659/319705. **BEDFORD** Computopia, Leighton Buzzard, 0525 376600. Comserve, Bedford, 0234 216749. Cavern Electronics, Milton Keynes, 0908 314925. **BERKSHIRE** P.C.P. Reading, 0734 589249. **BUCKS** Interface Components Ltd, Amersham, 02403 22307. Photo Acoustics, Newport Pagnell, 0908 610625. **CAMBS** Cambridge Micro Computers, Cambridge, 0223 314666. **CHESHIRE** Hewart Electronics, Macclesfield, 0625 22030. **CUMBRIA** Kendal Computer Centre, Kendal, 0539 22559. **DERBYS** Kays Electronics, Chesterfield, 0246 31696. T. Crossley, Chesterfield, 0246 850357. Lowe Electronics, Matlock, 0629 4995. **DORSET** Blandford Computers, Blandford Forum, 0258 53737. **ESSEX** Emprise, Colchester, 0206 865926. Compuskill, Romford, 0708 751906. Infolab, Chelmsford, 0245 357111. CSSC, Ilford, 01-554 3344. **GLOS** MPL Computers, Cheltenham, 0242 582090. Petrie Systems, Cheltenham, 0242 584060. **HERTS** Photo Acoustics, Watford, 0923 40698. Watford Electronics, Watford, 0923 40588/37774. Q Tek Systems, Stevenage, 0438 65385. Comp Shop, New Barnet, 01 4412922. **KENT** Matrix Computer Systems, Beckenham, 01 658 7508/7551. Optelco, Rayleigh, 0268 774089. Business Systems, Hempstead, 0635 362652. Thanet Electronics, Herne Bay, 02273 63859. The Computer Room, Tunbridge Wells, 0892 41645. **SMG** Microcomputers, Gravesend, 0474 55813. **LANCS** Computer Business Systems, Lytham St. Annes, 0253 730033. Microdigital, Liverpool, 051 227 2535. Mighty Micro, Burnley, 0282 32209/53629. Leisuronic, Blackpool, 0253 27091. Harden Microsystems, Blackpool, 0253 27590. ABC Supplies, Levenshulme, 061 431 9265. HR Control Systems, Chorley, 02572 75234/5. Computecat, Leigh, 0942 601818. Micro Chip Shop, Fleetwood, 03917 79480. Micro Chip Shop, Preston, 0722 22669/79511. Micro Chip Shop, Blackpool, 0253 403 122. Sound Service, Burnley, 0282 38481. **LEICS** Eley Electronics, Leicester, 0533 871522. Arden Data Processing, Leicester, 0533 22255. Kram Electronics, Anstey, 053721 3575. **LONDON (CENTRAL)** City Microsystems Ltd, London, 01 588 7272. Sumlock Bondain, E.C.1, London, 01 250 0505. **LONDON (NORTH)** Henry's Radio, London, 01 402 6822. Radio Shack, NW6, London, 01 624 7174. Comp Shop, 311 Edgware Rd, London, 01 262 0387. Chromasonic Electronics, N19, London, 01 833 3705. Davinci Computers, Edgware, London, 01 952 0526. Comp Shop, New Barnet, London, 01 441 2922. NIC, Tottenham, London, 01 608 0377. **LONDON (WEST)** Ecobits, Shepperton, 09322 20826. **NORTH EAST** H.C.S. Associates, Gateshead, 0632 821924. 3-Line Computing, Hull, 0482 859169. Derwent Radio, Scarborough, 0723 65996. Briers Computer Services, Middlesbrough, 0642 242017. General Northern Microcomputers, Hartlepool, 0783 863871. **NORTHANTS** Arden Data Processing, Peterborough, 0733 49577. **NOTTS** Electronic Servicing Co, Lenton, 0602 783938. University Radio Stores, Nottingham, 0602 45466. Midland Microcomputers, Nottingham, 0602 298281. East Midland Comp. Services, Arnold, 0602 267079. Mansfield Computer & Electronics, Mansfield, 0623 31202. **NORFOLK** Anglia Computer Centre, Norwich, 0603 29652. **OXFORD** Micro Business Systems, Witney, 0993 73145. Magnus Microcomputers, Kidlington, 08675 6703. **SALOP** Tarrant Electronics, Newport, 0952 812134. **SCOTLAND** Computer and Chips, St. Andrews, 0334 72569. Scotbyte Computers, Edinburgh, 031 343 1005. Esco Computing, Glasgow, 041 204 1811. Silicon Centre, Edinburgh, 031 332 5277. **SOUTH** Catronics, Wallington, 01 669 6700/1. Gemsoft, Woking, 04862 22881. Castle Electronics, Hastings, 0424 437875. Gamer, Brighton, 0273 698424. **SOUTH WEST** Diskwise Ltd, Callington, 05793 3780. Electrosure, Exeter, 0392 56280 56687. West Devon Electronics, Yelverton, 082 285 3434. **SUFFOLK** Rebvale Computers, Bury St. Edmunds, 095 381 316. Maishon Electronics, Ipswich, 0473 75476. Microtek, Ipswich, 0473 50152. **SURREY** Croydon Computer Centre, Thornton Heath, 689 1280. **SUSSEX** Nestra Electronics, Chichester, 0243 512861. **WALES** MRS Communications, Cardiff, 0222 616936/7. Morriston Computer Centre, Swansea, 0792 795817. Tryfan Computers, Bangor, 0248 52042. **WEST MIDLANDS** Ward Electronics, Birmingham, 021 554 0708. Allen TV Services, Stoke on Trent, 0782 616929. Microprint, Stoke on Trent, 0782 48348. **YORKS** Advance TV Services, Shipley, 0274 585333. Amateur Radio Shop, Huddersfield, 0484 20774. Thomas Wright, Bradford, 0274 663471. Photo Electrics, Sheffield, 0742 53865. Allan M. Plainer Ltd, Leeds, 0532 688397. Quadraphenia, Sheffield, 0742 77824. Scene and Heard, Halifax, 0422 59116. Spot Computer Systems, Doncaster, 0302 25159. **EIRE** Compshop, Dublin, 74933. D.B. Microcomputers, Limerick, 061 42733. **NORTHERN IRELAND** Business Electronic Equipment, Belfast, 0232 46161. **JERSEY** G.B. Organs, St. Saviour, 0534 26788/23564.

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MicroValue

New British Microsystem. Gemini MultiBoard



● Eight boards available NOW ● 8" x 8" board modules ● Z80A CPU board ● Z80A Video board ● 64K RAM ● Built and tested Developed by one of the most experienced micro board design teams in the UK, Gemini MultiBoard* is the ultimate modular board system. Unlike most systems of its kind, virtually nothing is made redundant when you expand it. And for those who want expansion this can be immediate, for we are launching eight boards simultaneously. No other system has offered so much so soon.

All MultiBoard modules are Nasbus† and Gemini 80-BUS* compatible and can be used in a wide spectrum of application, e.g. educational, personal, business, system development and process/production control.

MultiBoard modules are built and tested to the highest standards. And offer enormous computing power and potential at astonishingly low cost.

MultiBoard Modules available now

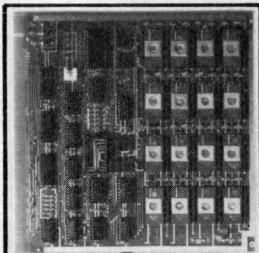
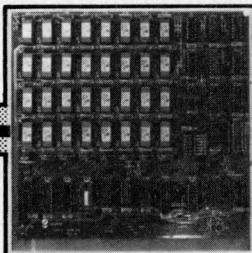
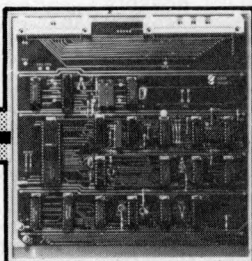
Z80A CPU

Processor: Z80A CPU at 4MHz. Optional wait-states. Reset jump to any 4K boundary.

Parallel I/O: 8 bit ASCII keyboard socket. Uncommitted Z80A PIO giving two 8 bit bi-directional ports with handshake.

Serial I/O: 8250 UART with programmable baud rates and software selectable between RS232 or 1200 baud CTS cassette interfaces.

Memory: 4 'ByteWyde' sockets to accept EPROM/ROM/RAM. Memory switched in/out of memory map under software control.



Software: Comprehensive monitor. Optional 12K Microsoft BASIC (ROM). Standard configuration PROM provides decodes for 4 x 2732 (4K x 8) EPROMs.

The CPU Board is fully buffered to the Gemini 80-BUS standard.

INTELLIGENT VIDEO

- Z80A microprocessor controlled.
- 80 x 25 display controlled by 6845 CRTG chip.
- Adjustable dot clock for alternative screen formats.
- Character set: 128 in EPROM + 128 in RAM which can be defined as the video inverse of the main set or as block graphics with 160 x 75 resolution.
- I/O port communication with host computer.
- Light pen socket.
- 8-bit input port allowing several video boards (each with its own keyboard) to be connected to a single CPU board.

FLOPPY DISK CONTROLLER

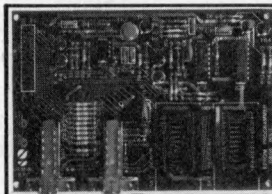
- Controls: Perfec FD250 5.25in 48 TPI, Micropolis 1015 5.25in 96 TPI, Perfec FD514 8in.
- Controls up to 4 drives of same type.
- Single/double density software selectable.
- Single or double sided.
- Western Digital FD1797 controller.
- Up to 8 drives (2 boards) can be used in the same system.

64K RAM

- Runs at 4MHz with no wait-states.
- 4 banks of 16K dynamic RAM, each bank locatable on any 4K address boundary.
- Page Mode supplied as standard allowing up to 4 memory boards to be addressed.
- All the memory can be used by switching out on-board CPU memory, e.g. in disk environment.

EPROM/ROM BOARD

- Accepts up to 40K of firmware.
- 4 banks of 4 sockets.
- Banks can be mixed between 2708 or 2716.
- 24-pin ROM socket.
- Wait-state generator.
- Supports Page Mode scheme.



EPROM PROGRAMMER

- Programs multi-rail 2708 or single rail 2716.
- Connects to PIO on CPU board.
- Software provided on tape.

3A PSU

- Supplies 4/5 boards.
- LED on each output.
- +5V at 3A; +12 at 1A; -5V at 1A; -12V at 80mA.

KEYBOARD

- Full alpha-numeric ● 59-keys ASCII encoded ● Exclusively designed for Gemini
- Auto repeat ● Cursor control keys

MULTIBOARD PRICES (excl VAT)

(All built and tested except where marked)

CPU (G811)	£125.00
Video (G812)	£140.00
64K RAM (G802)	£140.00
FDC (G809)	£140.00
EPROM/ROM (G803)	£ 70.00
EPROM PROG. (G808) Kit	£ 29.50
3A PSU (G807)	£ 40.00
Keyboard (G613)	£ 57.50

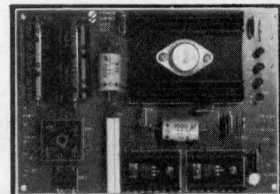
FLOPPY DISK UNIT

Gemini unit suitable for MultiBoard. Holds one or two 5¼in double sided, double density Perfec drives. Integral power supply. Price £375 plus VAT for one drive, £575 plus VAT for two drives. CP/M2.2 and documentation £90 plus VAT.

KENILWORTH CASE for MultiBoard	£49.50 + VAT
5-Card Support Kit	£19.50 + VAT
VERO Frame	£32.50 + VAT
(also suitable for Nascom)	
PSU Enclosure Kit	£24.50 + VAT
KEYBOARD enclosures available soon.	

MultiBoard Modules are available from the MicroValue dealers listed on facing page.

* Trademarks of Gemini Microcomputers Limited
† Trademarks of Nascom Microcomputers Division of Lucas Logic
‡ Trademarks of Digital Research Inc.



MicroValue

COMPATIBLE Nasbus products from your MicroValue Dealers

GEMINI G805 FLOPPY DISK SYSTEM FOR NASCOM-1 & 2

It's here at last. A floppy disk system and CP/M SYSTEM. The disk unit comes fully assembled complete with one or two 5 $\frac{1}{4}$ " drives (FD250 double sided, single density) giving 160K per drive, controller card, power supply, interconnects from Nascom-1 or 2 to the FDC card and a second interconnect from the FDC card to two drives, CP/M 1.4 on diskette plus manual, a BIOS EPROM and a new N2MD PROM. All in a stylish enclosure.

Single drive system **£450 + VAT**
Double drive system **£640 + VAT**
Additional FD250 drives **£205 + VAT**

D-DOS SYSTEM. The disk unit is also available without CP/M to enable existing Nas-Sys software to be used. Simple read, write routines are supplied in EPROM. The unit plugs straight into the Nascom PIO.

Single drive system **£395 + VAT**

DOS-DOS A greatly enhanced version of D-DOS, running under Nas-Sys. Gives named files in BASIC, ZEP, NAS-PEN and machine code programs **£50 + VAT**

DISPEN

The powerful text editor written for the Nascom is now available on a 5 $\frac{1}{4}$ inch floppy disk with a number of new features. **Price £43.25 + VAT.**

NASCOM COMPUTERS

NASCOM-2 Microcomputer Kit
£225 + VAT

NASCOM-1 Microcomputer Kit
£125 + VAT

Built and tested **£140 + VAT**

16K RAM KIT **£100 + VAT**
3A PSU KIT **£32.50 + VAT**

KENILWORTH CASE FOR NASCOM-2

The Kenilworth case is a professional case designed specifically for the Nascom-2 and up to four additional 8" x 8" cards. It has hardwood side panels and a plastic coated steel base and cover. A fully cut back panel will accept a fan, UHF and video connectors and up to 8 D-type connectors. The basic case accepts the N2 board, PSU and keyboard. Optional support kits are available for 2 and 5 card expansion.

Kenilworth case **£49.50 + VAT**
2-card support kit **£7.50 + VAT**
5-card support kit **£19.50 + VAT**

CASSETTE ENHANCING UNIT

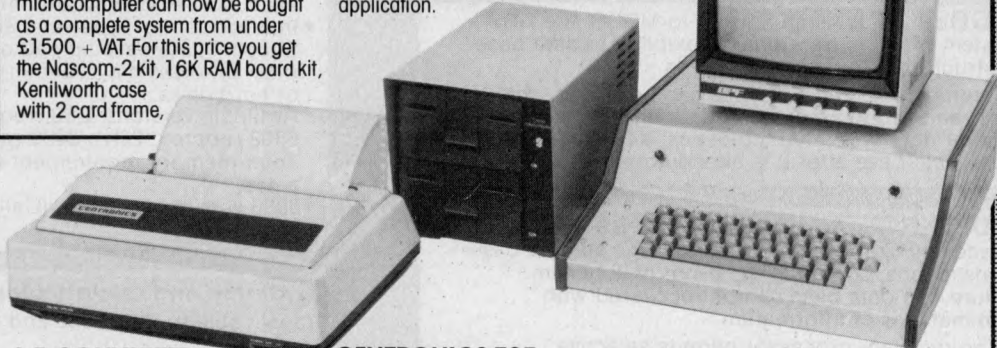
The Castle interface is a built and tested add-on unit which lifts the Nascom-2 into the class of the fully professional computer. It mutes spurious output from cassette recorder switching, adds motor control facilities, automatically switches output between cassette and printer, simplifies 2400 baud cassette operating and provides true RS232C handshake.

Castle Interface Unit **£17.50 + VAT**

A NASCOM-2 BASED SYSTEM FOR LESS THAN £1500 + VAT

The proven Nascom-2 microcomputer can now be bought as a complete system from under **£1500 + VAT.** For this price you get the Nascom-2 kit, 16K RAM board kit, Kenilworth case with 2 card frame,

Centronics 737 printer—10 inch monitor, and the Gemini Dual Drive Floppy Disk System. The CPU and RAM boards are also available built—the additional cost is available on application.



A-D CONVERTER

For really interesting and useful interactions with the 'outside world' the Milham analogue to digital converter is a must. This 8-bit converter is multiplexed between four channels—all software selectable. Sampling rate is 4KHz. Sensitivity is adjustable. Typical applications include temperature measurement, voice analysis, joystick tracking and voltage measurement. It is supplied built and tested with extensive software and easy connection to the Nascom PIO.

Milham A-D Converter (built and tested) **£49.50 + VAT**

PROGRAMMER'S AID

For Nascom ROM BASIC running under Nas-Sys. Supplied in 2 x 2708 EPROMs. Features include: auto line numbering; intelligent renumbering; program appending; line deletion; hexadecimal conversion; recompression of reserved words; auto repeat; and printer handshake routines. When ordering please state whether this is to be used with Nas-Sys 1 or 3. **Price £28 + VAT.**

GEMINI 'SUPERMUM'

12 x 8 piggy-back board for Nascom-1 offering five-slot motherboard, quality 5A power supply and reliable buffering with reset jump facility. **Kit Price £85 + VAT.**

CENTRONICS 737 MICRO PRINTER

A high performance, low price, dot-matrix printer that runs at 80cps (proportional) and 50cps (monospaced). This new printer gives text processing quality print. And can print subscripts and superscripts. It has 3-way paper handling and parallel interface as standard. Serial interface is optional. **Price £375 + VAT.** Fanfold paper (2000 sheets) **£18 + VAT.**

BITS & PC's PCG

5 x 4 board which plugs straight into Nascom-2. Operates on cell structure of 128 dots, producing 64 different cells. Once defined, each cell may be placed anywhere, any number of times on screen simultaneously. Max screen capacity: 768 cells. Dot resolution: 384 x 256 98304. Many other features including intermixing of alpha-numeric characters and pixels. **Price (kit) £60 + VAT.**

PORT PROBE

Allows monitoring of input and output of Nascom PIO. This board can generate interrupts and simulate handshake control. **Price (kit) £17.50 + VAT.**

All prices are correct at time of going to press and are effective 1st July 1981.

HEX & CONTROL KEYPADS

Hexadecimal scratchpad keyboard kit for N1/2; **Price £34 + VAT.**

As above but including (on the same board) a control keypad kit to add N2 control keys to N1. **Price £40.50 + VAT.**

BASIC PROGRAMMER'S AID

Supplied on tape for N1/2 running Nas-Sys and Nascom ROM BASIC. Features include auto line number, full cross-reference listing, delete lines, find, compacting command, plus a comprehensive line re-numbering facility. **Price £13 + VAT.**

'SCREENPLUS'

Screenplus enables a programmer to blank or display in reverse video, selected words, letters or areas of the screen under program control. Suitable for use with either Nascom 1 or 2. 'Screenplus' (built and tested) **£40.00 + VAT.**

DUAL MONITOR BOARD

A piggy-back board that allows N1 users to switch rapidly between two separate operating systems. **Price (kit) £6.50 + VAT.**

YOUR LOCAL MICROVALUE DEALER

All the products on these two pages are available while stocks last from the MicroValue dealers listed below. (Mail order enquiries should telephone for delivery dates and post and packing costs.) Access and Barclaycard welcome.

BITS & PC'S
4 Westgate, Wetherby, W. Yorks.
Tel: (0937) 63774.
BUSINESS & LEISURE
MICROCOMPUTERS
16 The Square, Kenilworth, Warks.
Tel: (0926) 512127.

ELECTROVALUE LTD.
680 Burnage Lane, Burnage,
Manchester M19 1NA.
Tel: (061) 432 4945.
28 St Judes, Englefield Green,
Egham, Surrey TW20 0HB.
Tel: (0784) 33603. Tlx: 264475.



TARGET ELECTRONICS
16 Cherry Lane, Bristol BS1 3NG.
Tel: (0272) 421196.

INTERFACE COMPONENTS LTD.
Oakfield Corner, Sycamore Road,
Amersham, Bucks.
Tel: (02403) 22307. Tlx: 837788.

HENRY'S RADIO
404 Edgware Road, London W2.
Tel: (01) 402 6822.
Tlx: 262284 (quote ref: 1400).

The best in data base management for your micro-computer

Get the most out of your micro-computer. Use our advanced and progressive data management system.

HDBS is an extended hierarchal data base system offering

- fixed length records
- file-level read/write protection
- one-to-many set relationships

MDBS is a full network data base system offered as an upgrade from HDBS... or it may be ideal as your initial system. **Unique and versatile**, it adds these features:

- full network CODASYL-oriented data structures
- variable length records
- multiple levels of read/write protection
- one-to-one, many-to-one, and many-to-many sets
- non-redundancy of data, easy updating
- occurrences of a record type may own other occurrences of the same type
- a single set may have multiple owner and member record types

MDBS-DRS. As an add-on to MDBS, the DRS system offers extraordinary flexibility in data base restructuring to meet new needs.

- Item, record, and set types can be added, deleted, or renamed in an existing data base as well as other data base characteristics. You can redesign the data base after it is already on-line!

MDBS-RTL. As an add-on to MDBS, the RTL (Recovery Transaction Logging) logs all data base transactions, so that in the event of a system failure, the data base can be recovered with minimal loss of information.

- The recovery processor permits selective reloading of the data base from the transaction file. Users can log messages, indicate complex transaction sequences, and effect selective control over the recovery process.

MDBS-QRS. An interactive Report-Writer/Query-System for HDBS/MDBS data bases. Features...

- may be customized for non-technical users
- complex retrieval conditions may be specified
- detailed reports can be quickly generated
- wildcard and "match-one" string specifications included

HDBS and MDBS Packages Include:

- DDL data definition language analyzer/editor
- 260-page users manual
- DMS data management routines callable from host language
- Sample application program and DDL files
- Relocator to re-org all routines
- System specific manual for bringing up our software



Coming soon: Multi-User Versions of MDBS, and a Z8000 Version.

54-page "primer" on data base systems for micro-computers - only £5.00 per copy.

NEW!

NEW!

Both HDBS and MDBS Systems...

- Run under...
CP/M with Microsoft BASICs, FORTRAN or COBOL; InterSystem PASCAL/Z; Sorcim PASCAL/M; Micro Focus CIS COBOL; Digital Research PL/I
MVT/FAMOS with BASIC
OASIS with BASIC
TRSDOS and NEWDOS (Models I and II) with Disk BASIC
North Star DOS with North Star BASIC
Apple DOS and Applesoft BASIC
Machine Language Interface available on all above systems.
- Up to 254 record-types definable in the data base; each record-type may contain up to 255 item-types; each item-type may be up to 9,999 bytes in length.
- Names of data items, records, sets, and files are wholly user definable.
- Commands to add, delete, update, search, and traverse the data base.
- Straightforward use of ISAM-like structures.
- Records can be maintained in several sorted orders.
- Written in machine language for maximum execution efficiency and minimal memory usage.
- Independent of types and sizes of disk drives. Support data base spread over several disk drives (max.8); disks may be mini- or full-sized floppies or hard disks.
- Available versions: Z80 (requires approx. 18K), 6502 (approx. 26K), 8080 (approx. 22K)
Total memory requirement must allow for buffer areas.
- 8086 version available. (Call or write for details and prices.)

Ordering and pricing information:

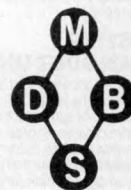
(applicable to Z80, 8080 and 6502 versions):

HDBS	£235.00	When ordering, specify intended use with...
MDBS	600.00	
DRS	150.00	1. North Star DOS and BASIC
RTL	150.00	2. CP/M - Microsoft BASIC 4.XX
QRS	300.00	3. CP/M - Microsoft BASIC 5.XX
HDBS upgrade to MDBS	440.00	4. CP/M - Microsoft BASIC Compiler or FORTRAN-80
MDBS with DRS, RTL and QRS	950.00	5. CP/M - Microsoft COBOL-80
HBDS/MDBS Manual	30.00	6. CP/M - InterSystem PASCAL/Z
DRS Manual	5.00	7. CP/M - Sorcim PASCAL/M
RTL Manual	5.00	8. CP/M - Digital Research PL/I
QRS Manual	5.00	9. CP/M - Micro Focus CIS COBOL
System Specific Manuals each	5.00	10. TRSDOS/NEWDOS and TRS Disk BASIC (Models I and II)
Within a given operating system, add £240 for each additional language selected.		11. Apple DOS and Applesoft BASIC
		12. MVT/FAMOS and BASIC
		13. OASIS and OASIS BASIC
		14. Machine Language Programs (Specify operating system)

Finally, our software may cost a little more... but it's worth a lot more in quality and versatility.

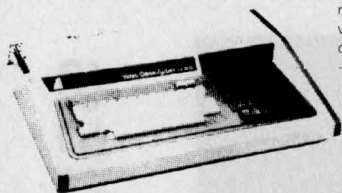
Micro Data Base Systems from

SYSTEMS PLUS LTD.,
19c Glengormley Park, Newtownabbey BT36 7RE.
Tel: Glengormly 42117.



THE Video Genie EG3000 Series

WITH *16K user RAM plus extended 12K Microsoft BASIC in ROM *Fully TRS-80 Level II software compatible *Huge range of software already available *Self contained, PSU, UHF modulator, and cassette *Simply plugs into video monitor or UHF TV *Full expansion to disks and printer *Absolutely complete - just fit into mains plug.



16K **£299** + VAT

GP80 The most compact 80 column impact graphic-dot printer available - at a very compact price

by seikosha

Graphics, Normal and Double-Width Characters can be printed on the same line. Pine Feed Tractor is equipped as standard.

Two Line-Feed Commands (1/6 and 1/9 inch)

Print on Plain Paper with two copies

Continuous Self-Inking Ribbon for easy handling

Centronics type Parallel Interface standard

Wide Range of Optional Interface Boards

Self-Test Programme standard



£225 + VAT

SUPERBRAIN

SuperBrain's CP/M operating system boasts an overwhelming amount of available software in BASIC, FORTRAN, COBOL, and APL. Whatever your application... General Ledger, Accounts Receivable, Payroll, Inventory or Word Processing, SuperBrain is tops in its class.

320K **£1850** 700K **£2400**
1.5Mb **£2750**

COMMODORE COMPUTERS

PET 8K	£415
PET 16K	£525
PET 32K	£650
PET 8032	£895

DISK DRIVES

4040	£695
------	-------------

PRINTERS

EPSON TX80B (inc. I/F & cable)	£299
EPSON MX80T	£395
ANADEx DP8000	£495
ANADEx DP9500	£895
ANADEx DP9501	£995

VIDEO MONITORS

10" BLACK & WHITE	£85
10" GREEN SCREEN	£95

Aculab

Floppy Tape

The tape that behaves like a disk.

Connects directly to TRS-80 level 2 keyboard. Operating and file handling software in ROM 8 commands add 12 powerful functions to level 2 BASIC. No buttons, switches or volume controls. Full control of all functions from keyboard or program. Maintains directory with up to 32 files on each tape.

for all TRS 80
& Video Genie owners

TRS80 version:	£165
Video Genie :	£170

Please add **£10** Securicor delivery charge to all computers etc.
Plus 15% VAT on all prices.

Acorn Atom



£150
plus VAT and disk

Unique in concept —
the home computer
that grows as you do!

Special features include

- *FULL SIZED KEYBOARD
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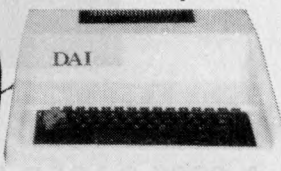
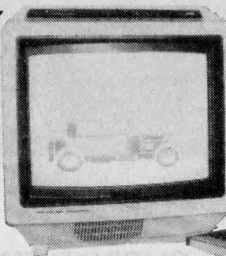
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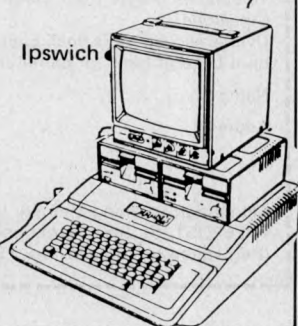
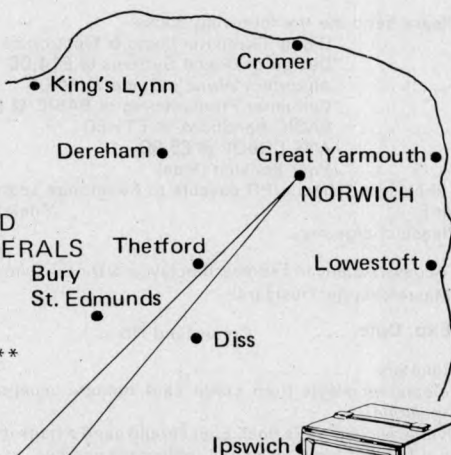
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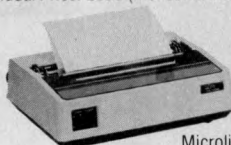
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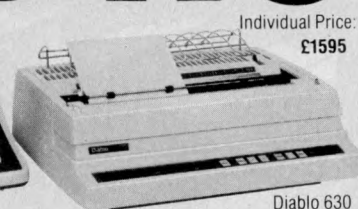
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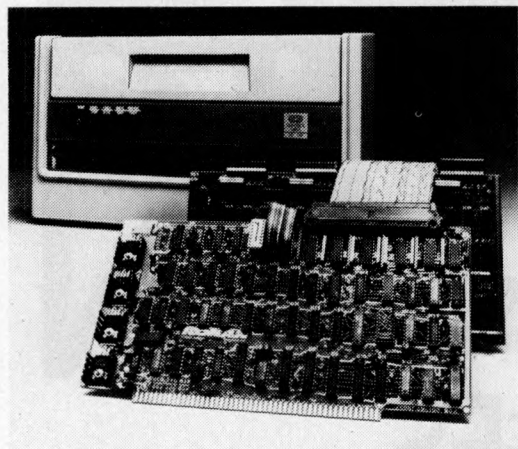
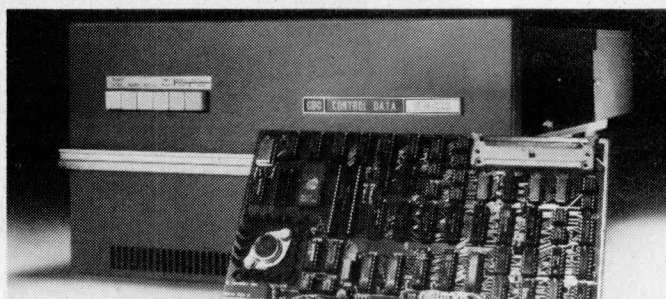
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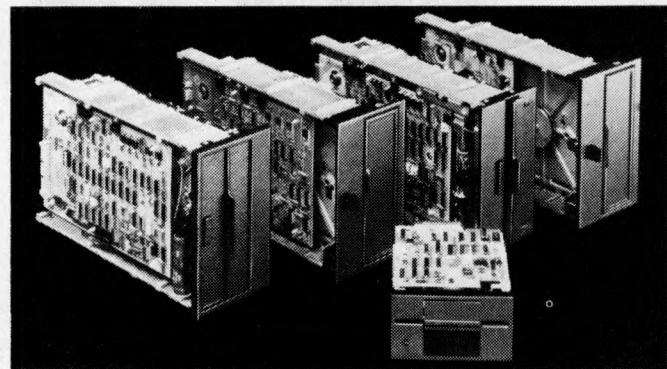
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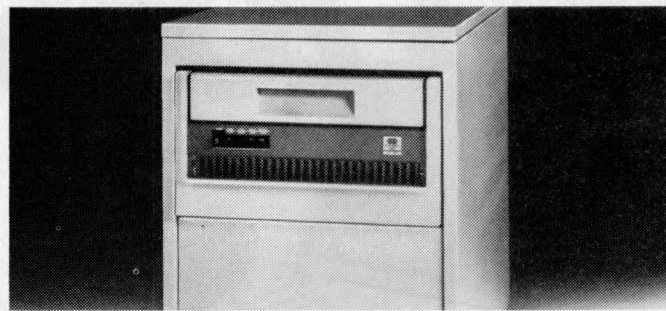
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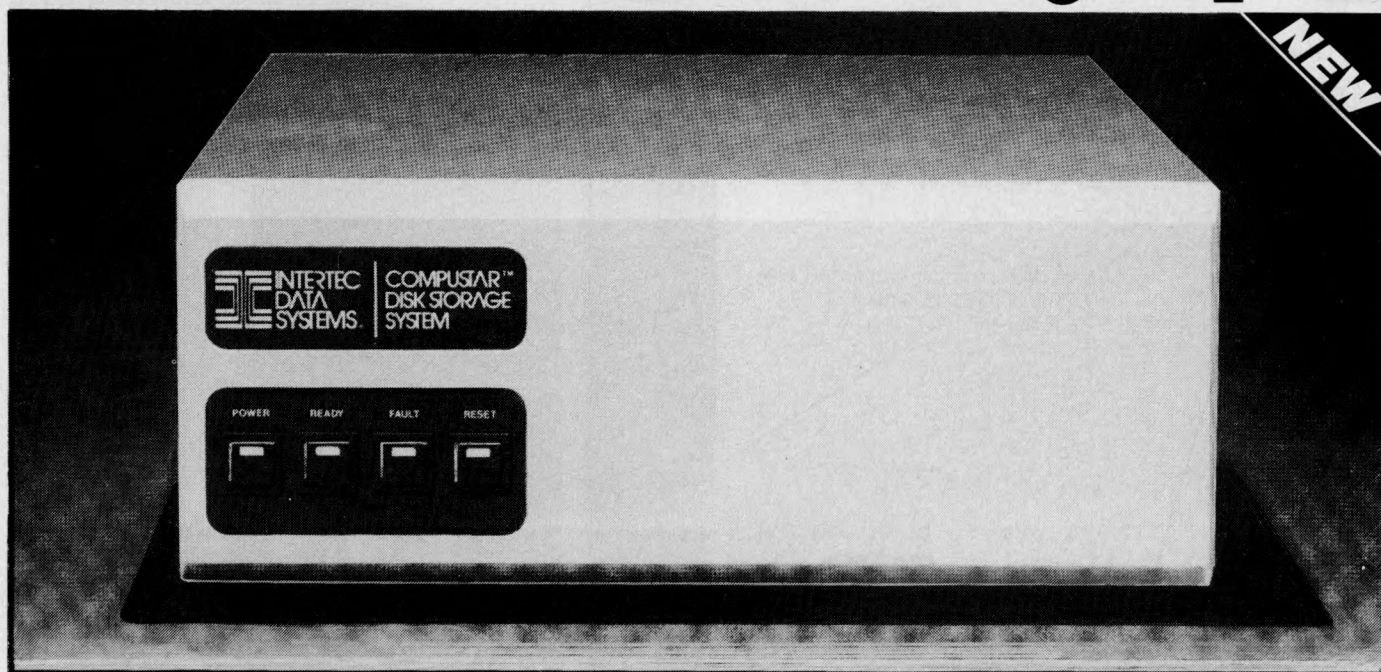
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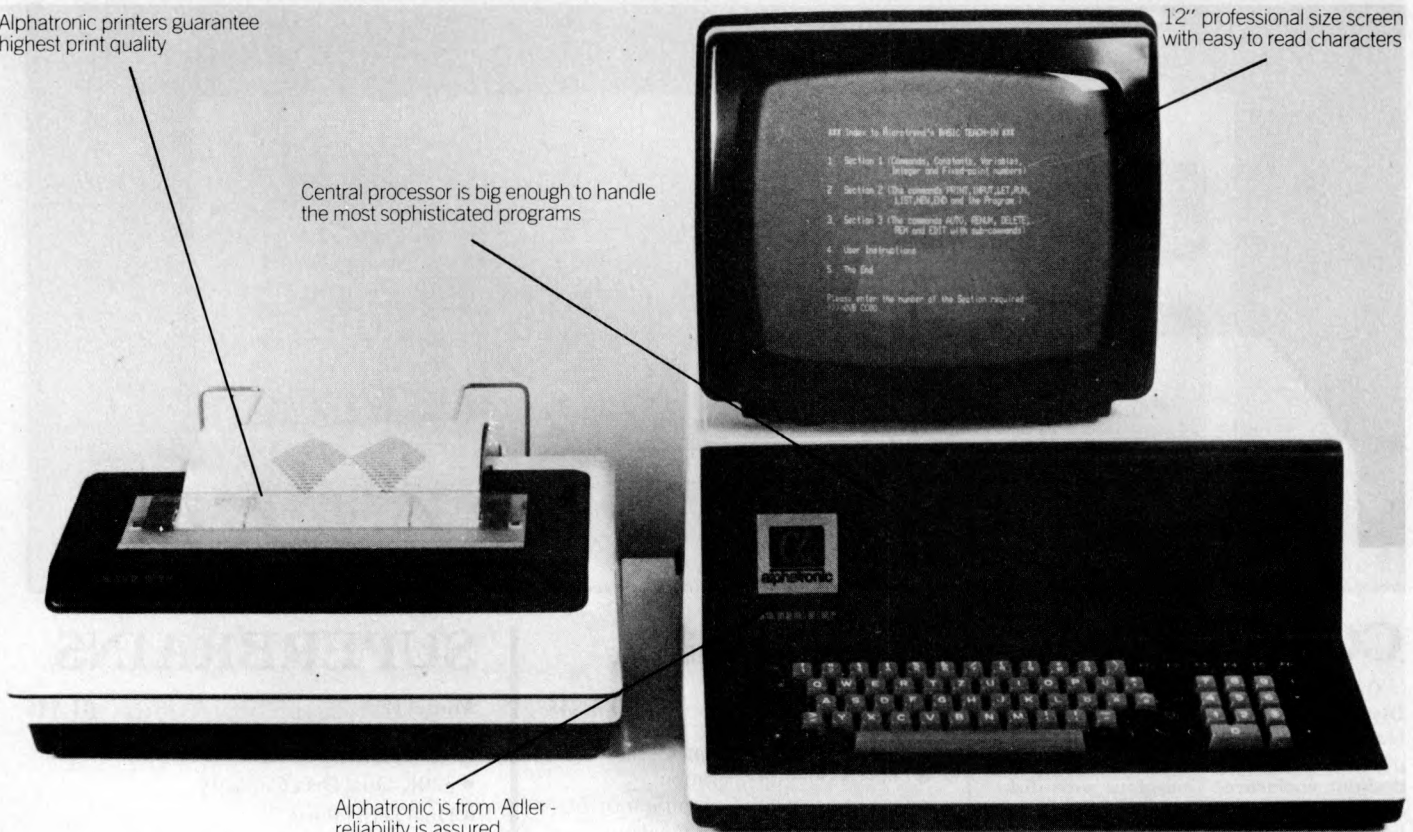
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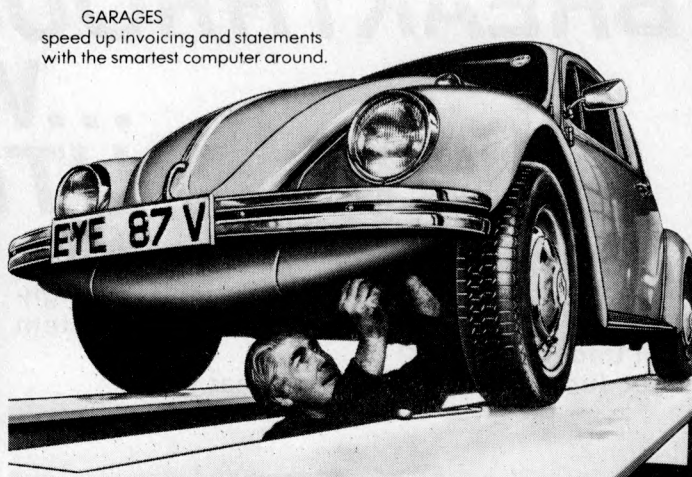
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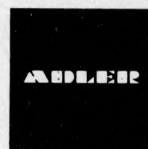
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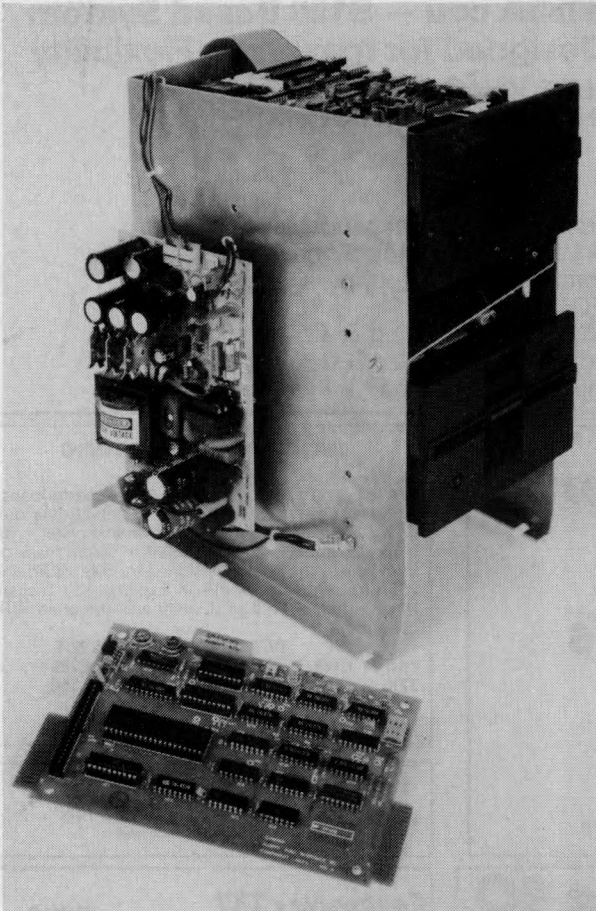
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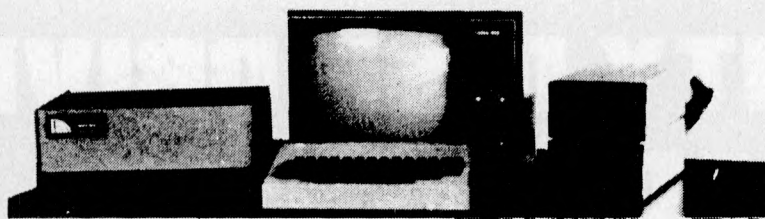
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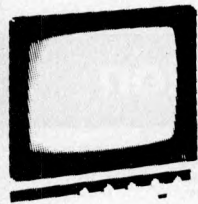
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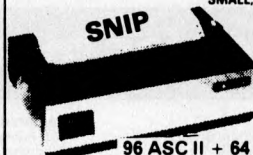
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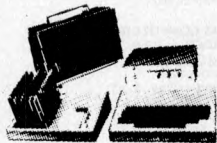
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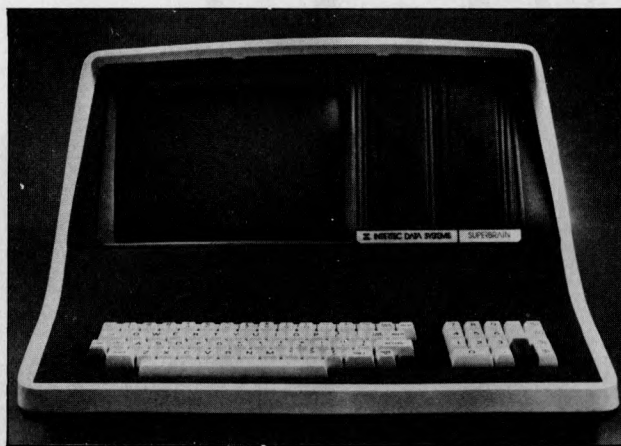


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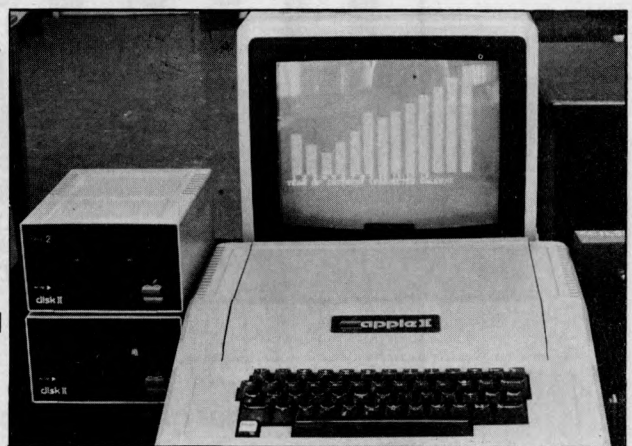
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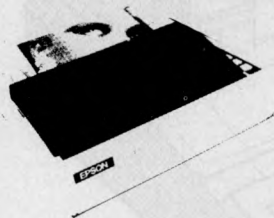
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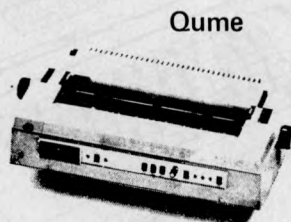
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GAMMON GAMBLER
BRIDGE PARTNER
80 VISICALC DISK & BOOK COMPLETE
MILLIKEN MATHS PACKAGE
ESTATE AGENTS (RES. PROPERTIES)
MICROBASE MAILING LIST
MICROCHASE STOCK CONTROL

DOCUMENTATION

APPLE II REFERENCE MANUAL
6502 HARDWARE MANUAL
6502 SOFTWARE MANUAL
APPLE II BASIC PROGRAM MANUAL
APPLESOFT II REFERENCE MANUAL
DOS 3.2 MANUAL
APPLE II BASIC TUTORIAL MANUAL
AUTOSTART ROM MANUAL

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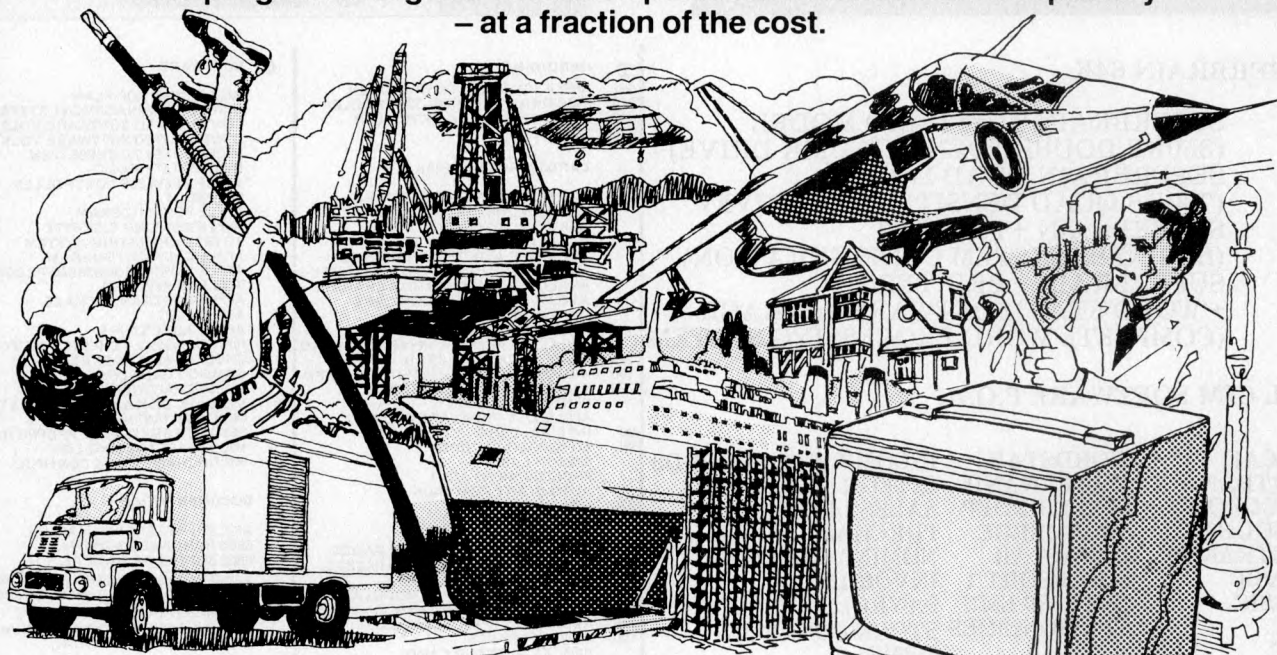
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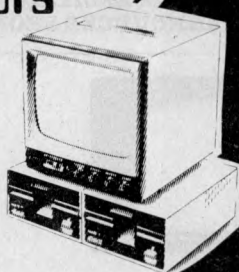
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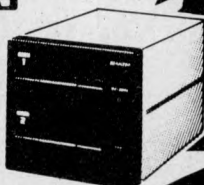
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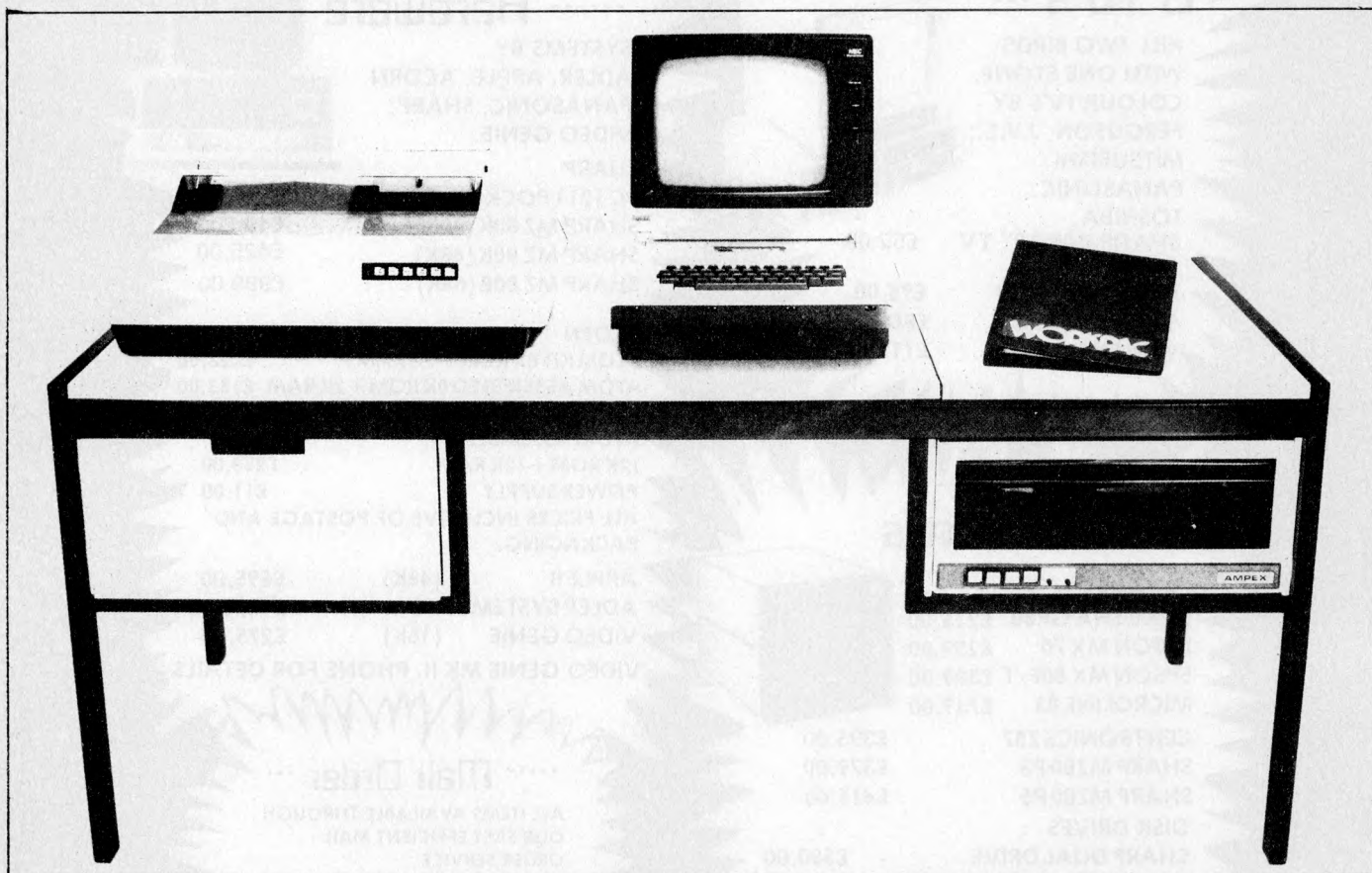
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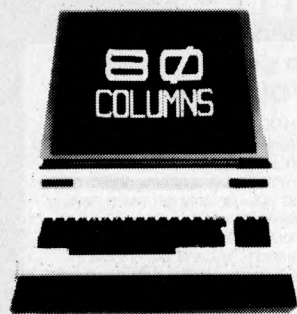
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Each Generator gives 3 octaves.
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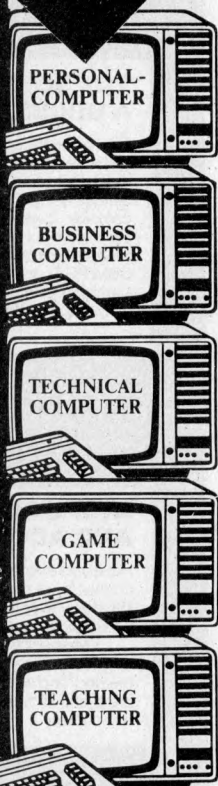
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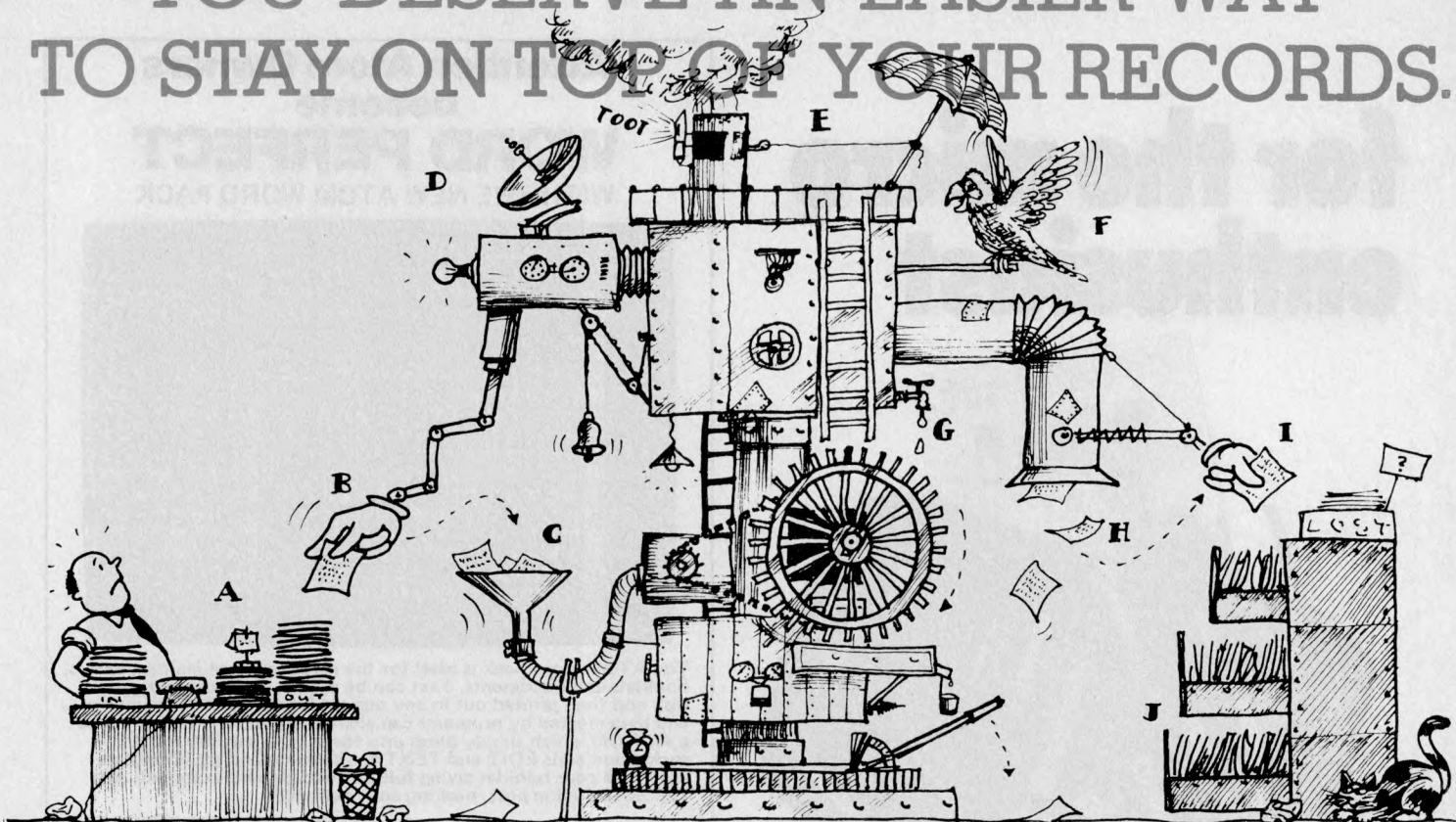
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HEX START ADDRESS=083F
END ADDRESS=0840
CPU OPT10=V
CODE STORAGE TEXT SPACE:
'EQU 029'H
83F0 24 91 BPT 091
83F1 10 11 BPL -8374
83F3 A9 00 LDA #000
83F4 85 89 STA 200A
83F6 85 8D STA -8D
83F8 85 8C STA -8C
83F9 A9 0A LDA #0A
83FB 85 8B STA -8B

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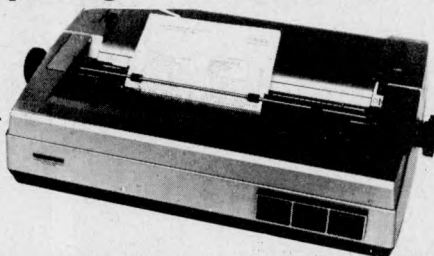

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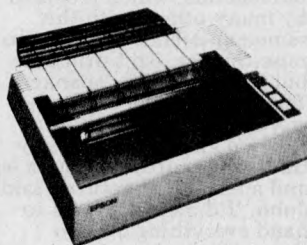
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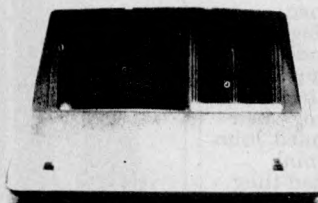
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Guy Kewney, editor of Datalink, brings his latest compilation of news, gossip, rumours and hard micro-facts.



Gemini re-born

Remember the Gemini? No? I'll remind you: Last year John Marshall, founder of Nascom, announced a boxed, desk-top computer called the Gemini; he even exhibited it at Compec. It looked very promising — 64k RAM, Z80A CPU, twin disks, running CP/M, nice cabinet, a promised low price.

And then a long silence, punctuated occasionally by rumours of Problems. It began to look as though the Gemini was stillborn.

Now, suddenly, the Gemini is back and by the time you read this, production will be winding up to an eventual 1000 per month.

The story of the Gemini's rebirth, as told by John Marshall, goes like this. John had designed the Gemini with a view to fairly low volume production — manufacturing was to be carried out almost on a cottage industry scale, in fact. At Compec, however, he was so overwhelmed with potential buyers that he had to revise his plans and think in terms of mass production.

Now, if you're designing a machine for high volume production, a lot of things become very important which would be insignificant if you were designing for cottage industry production. On a low volume machine, for instance, you can afford to scatter resistors around the PCB, while for high volume you've got to use resistor networks (one component to insert instead of eight), which calls for a redesign of the PCB.

So John had to redesign the large, single board at the heart of the Gemini, which took time. Worse, the computer-aided design system used for the PCB design cocked it up — to the extent that the design it produced needed over 100 alterations before it would work. The only solution was to redesign the board yet again, but by hand, which took even longer.

Man cannot live by breadboards alone, however; John also needed financial backing to get into production. He did the rounds of the various government departments

supposed to be helping people like him, only to be faced with impenetrable bureaucracy. (His opinion of those bureaucrats, which is shared by many others with the same experience of trying to raise finance, isn't printable but it rhymes with 'spankers'.) The City and the big banks weren't much use, either: 'They'd give me the money but they wanted an arm, a leg and a left nut in return,' said John. 'I'd basically have to hand everything over to them, leaving me as an employee.'

Things weren't looking too bright until John had a phone call from Manas Heghoyan. Remember him? He's the man who tried unsuccessfully to buy John's old company, Nascom. They'd met at Compec, when the Nascom/Heghoyan negotiations were under way. Manas had had his appetite for micros whetted by the Nascom non-deal and, when he subsequently phoned John and heard of his Gemini problems, he suggested they get together.

The result is a company called British Micro, made up equally of John Marshall and Manas Heghoyan; Manas will handle the manufacturing (he has his own PCB making plant) and John will handle marketing. The machine, properly called the Gemini 801, will already have been shown to dealers by the time you read this and will be on sale soon, say John and Manas.

The Gemini's spec remains impressive; as well as the features mentioned above, it will have an 80 x 25 display, high resolution graphics, an RS232 printer port and will come with CP/M 2.2 and a 24k Microsoft Basic. All for the very interesting price of £1195 plus VAT. Add £150 or so for a decent monitor and it'll still give machines like the SuperBrain and even, possible, the Osborne 1 a run for their money.

British Micros is at Unit Q2, Penfold Works, Imperial Way, Watford, Herts, tel: Watford 48222.

BBC decides

Good news from inside the BBC computer project. First, the estimates of how many machines might be needed have been substantially upgraded, to 50,000 or more in the first year. And second, prototypes have been delivered on time, with most of the Basic working, as well as the incredibly high resolution graphics.

Actually, this latest milestone was reached at the beginning of June, and was kept a pretty good secret in-

side. Even people working on the program were to be found going around with long faces, saying that the prototypes hadn't been done, and nobody seemed to care. And well-known industry pessimists were seen stating categorically that the graphics were theoretically too detailed to produce a picture on a television screen. This last was scotched by the Department of Industry's Micro Applications Project people, who say that it does work. 'Anyway,' said one Warren Spring monitor,



By itself, the Voice Stress Computer is not a Lie Detector, claims Group One Investments. All it does is measure the presence of inherent micro-tremors in a subject's vocal pitch. It is simply a matter of adjusting the Voice Stress Computer to the normal level of micro-tremors present in an individual before accurate indications of stress can be obtained. You get this through two small lights, a green one indicating that the subject is not under stress and a red one indicating the presence of an above-normal stress. It costs £145 and, in order to use one, all you have to do is prove that the person you suspect of lying actually feels stress as a result of lying (and also get them to say something they find soothing, first). Could be tricky with most insurance salesmen to whom lies come as naturally as sex, and who live under absolutely permanent stress anyway. Have you had any micro-tremors lately?

'the thing was designed by the same guy who designed the BBC2 clock, which is computer generated. Had you noticed? The second hand doesn't jerk like the BBC1 clock does. And if I'm asked to take his advice or that of some theoretician who says it can't work, I'll take his — don't you think?'

I agree, but I still don't know who is going to be making all those BBC micros, now that the full spec is available.

(answer=Clearstone + ICL Logiclayer — Ed.)

Chess challenge

For a man who made his reputation proving the limitations of computers that play chess, David Levy doesn't half make a lot of money out of programming computers to play chess.

It's all a matter of what you compare things with, probably. By comparison with Levy, an International Master, even the smartest computer chess program takes a back seat. By comparison with me, even the sillier programs for the Atari look brilliant.

So Levy's own program for the PET, devised with Kevin O'Connell, who is president of the World Chess Federation Western Europe, at £17.50 on disk, is probably well worth a game.

Details on 021-501 2284, which is ACT Petsoft.

Cheapest yet

Probably the lowest cost per byte of data stored! A new disk drive from Sintrom comes complete with that bold claim.

Judge for yourself: it is a 5¼in mini winchester hard disk, with a maximum capacity of 16 megabytes, and it costs £1206. There are smaller drives, offering 10.7 megabytes for £1013, and the smallest, offering 5.3 megabytes, costs £825. Talk to them on 0734 85464 for details of how to interface it to your microsystem.

Network note

It's a fairly safe bet that nobody in this country is planning to release a program like SMART, which has just been announced in the US to control data transfer between two Tandy computers in two different buildings, over the phone.

The software is available for the two cheaper TRS-80 machines, the old Model I and the new Model III, for \$80 and \$100 respectively, and there probably isn't anything all that smart about it that any UK software



The re-born Gemini — see facing page.

producer couldn't have done.

What there isn't, in this country, is any way of launching the cheap modem that Tandy sells in the US, to link a computer to the phone line. Next time British Telecom tells you how its policies are designed to look after us all, get them to explain why not. It'll be good for a dry laugh.

The software is produced by The Microp peripheral Corporation of Mercer Island, Washington 98040, phone (206) 454 3303. It may be of some use in connecting machines together in networks, perhaps.

TV programs

All we really need now is a way of making radio and television go backwards and we can correct the software broadcast by the BBC and ITV for use on school computers. When that happens, the school computer in question, made by Mullard, may become a new force in the industry.

If you are now saying 'but I never heard of a computer made by Mullard,' don't feel left out, because most people haven't. This one is an experimental one, made to receive and run programs transmitted by Ceefax and Oracle — those pages of abbreviated news which appear on certain TV sets when there aren't any good programs to watch.

The experiment is being conducted from Brighton Polytechnic, under the leadership of Andrew Wallis, who's a senior computer officer there. It involves pages from the central broadcasting authorities which don't make any obvious sense to human viewers because the characters that come down are lines of Basic — and in this case, lines of a fairly advanced Basic, because Mullard's interpreter occupies 24 kbytes.

The way Mullard and Brighton have organised the experiment, the programs which school children will run will be on certain pages and the data which programs need will be on others. This means that the programs could be quite complex, but (theoretically at least) only a very simple

initial program need be loaded, with the initial program doing the job of loading other pages and linking them together. And if the program wants to perform calculations on tax problems, details such as the bank rate for the day can be fetched automatically. All the programmer needs to know is what page the FT Index (say) is on and write the necessary commands to scan that page.

The advantage over a normal 'distributed terminals' system is that the central data supply system need not know how many people are using the information. It takes no longer to broadcast a program to five million users than it does to transmit it to one.

The drawback, however, is that if there is a problem, you have trouble letting the BBC know about it. If yours is a 'distributed terminal' then you just send a message back to the central computer, but nobody has yet found a way to tell the broadcasting authorities that their code is full of bugs. Details of Mullard's computer are available from Mullard Application Laboratory, c/o G O Crowther, New Road, Mitcham, Surrey CR4 4XY.

Odd characters

Many owners have probably bought a printer called the

Epson MX-80, because they wanted to see the words on the PET screen kept permanently. However, if the screen included the many clever graphics that the PET can draw, these would have to be edited out of the screen before printing, because this range of printers doesn't have PET graphics. They can be provided by installing a new memory chip which has been pre-programmed by Micro Electronics of 32 Orchard Avenue, Worthing, West Sussex.

The designers, Martin Snow and John Nuttall, also offer a 'custom character generator' service — by which they mean you can design your own crazy alphabet or graphics characters, and they will make your PET produce it.

Cheap, cheap

We ought to be very grateful to the people who, a year ago, were paying £1000 and more for printers. They have bought so many that now, I notice with glee, a price of £215 is being quoted as a bottom line (bulk, trade only) by Peripheral Hardware on the Oki Microline range. Details from Peter Baxter on 01-941 4806 — and just remember, by this time next year, they'll be even cheaper.

Adam's choice

It may turn out that some of the dealers who wanted to stock Adam Osborne's new portable computer made the trivial mistake of not paying their Computer Bookshop bills on time. The computer itself has been dismissed as an idle dream or a fantasy, because of its very impressive specification and very low price. But I've seen the first production unit, and it's real.

Perhaps the Osborne 1 hasn't been given the attention in this column that it deserves, partly because Tom Williams wrote it up when



This rather tatty photo comes from Mike Sterland's Personal Computers Ltd. It shows the Discovision video disk player hooked up to a TV screen and an Apple. The disk can hold up to 54,000 images — one per track. Mike tells us that the player will be available for around £1500 and the disks will cost around £5 each; Mike didn't say whether this was wholesale or retail. For further info, contact Mike on 01-626 8121. See him at the PCW show or write to PCL at 194-200 Bishopsgate, London EC2M 4NR.

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The XCOMP ST/S Winchester controller is a custom-designed microprogrammable controller which consists of two S100 bus printed circuit boards. The ST/S controller is compatible with the 5 and 10Mb disk drives. These drives are formatted with 32 256byte sectors per track. With four heads and 153 cylinders the drives provide a formatted capacity of 5.0 megabytes.

Software: HMSOS or CP/M

Users have a choice of software; either the high-performance HMSOS single/multi-user operating system or CP/M.

Complete upgrade for Horizon

An upgrade kit for existing North Star Horizon owners contains all the hardware required — three S100 cards and the drive itself. Fitting to the Horizon is straightforward — no soldering is required and the Winchester is held by the same screws as the floppy drive it replaces.

HMS S100 power card

The mini-Winchester drives require higher supply currents than floppy drives. We have had an S100 card designed which provides the necessary supplies to connect to the Winchester.

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Hotel Microsystems Ltd

first news was available and then David Tebbutt did the report from the West Coast Faire, and partly because it looked to me as if it could be delayed.

To remind you: this is the machine that costs half as much as a SuperBrain but has the same type of specification, plus it's portable, plus it has masses of free software.

Osborne himself breezed into London in late June with the first plastic case I've seen (at the show it was in an aluminium case) and complained unconvincingly that at 25lb it was still 'too heavy' for him. He should carry my briefcase when I come home loaded down with the month's press releases to write this stuff.

He was also keen to interview ten dealers, whom I think it's safe to describe as the pick of the bunch. Some of these, to my annoyance, turned out to be people who originally were sceptics and who didn't believe the first price quoted, of £800. Even more annoyingly, they were right. Osborne says it isn't his fault, it's the falling pound, and the price will now be just under £1000, unless, of course, the pound falls further.

The machine remains worth buying almost for the free software alone. Several machines these days come complete with CP/M to load and run programs but they aren't in this price patch. They don't also offer Wordstar nor CBasic and MBasic equally free. And Mail/Merge is quite a new package and Supercalc is one which Osborne commissioned from the makers of Visicalc, specially to run under CP/M.

One theory popularly used to explain how all this expensive code got into the price suggests that the directors of the companies which own the rights are all directors of Osborne Computers. Osborne denies this: apart from the Wordstar man, his board of directors is made up of finance wizards, he says. All he's done is to buy his parts and ingredients 'aggressively' on the grounds that he'll sell as many computers as he is going to make and he's going to make an awful lot. The figures which I published earlier are now revised 'way upwards'.

At this stage, nobody has told me they've got the franchise but Byte Shop is very optimistic indeed. The only surprises about the dealers chosen for interview were one or two big names which weren't there. For libel reasons, I can't say which one it was that Osborne told me he'd rejected 'because I hear they're slow to pay their bills' but I did get a call from one retail chain afterwards, from a man who claimed that the names chosen were all recommended by Computer

Bookshop.

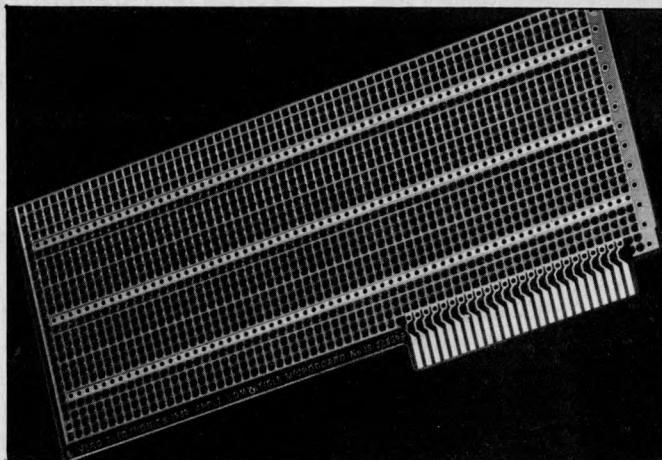
If there are any retailers out there who owe CB money, pay up now. You never know what opportunity may slip next.

Powerful PET

It is only when you work yourself up to be adequately enthusiastic to announce 'Fortran on the Alpha Micro' that you understand just what a wonderful package Commodore has put together on its micromainframe. Alpha Micro has announced just one new language (admittedly an important one) for just one computer (admittedly an

rather than sell a few machines at a higher price. You get so many more clever users, just by the laws of averages. In Commodore's case, the clever user is Professor Wes Graham of University of Waterloo, Ontario and what his University has done is to produce a machine which is absolutely identical, for software development, to a big IBM, or a big DEC computer. It works like this.

In the University, programmers write in a wide variety of languages, including Fortran and Pascal, on the big machines. Two years ago, they would sit down in front of a keyboard which was



Not all of us are satisfied to buy other people's add-in boards for our Apple computers; some of us want to prove to ourselves that it can't be done first. We use prototyping boards, like this one from Vero, which will plug in, and onto which we can connect all our mistakes, and from which we can remove the melted residue afterwards and try again. Details on (04892) 5727.

interesting one). Commodore, on the other hand, has inherited a long list of languages, including Fortran and Pascal, from the successful family of language compilers developed at the University of Waterloo in Canada.

The Alpha isn't exactly a common-garden sort of micro, since it uses 16-bit memory words, rather than the half-size eight bit bytes of most cheap systems. However Alpha Micro hasn't taken advantage of this fact to any great extent; it has produced a compiler that will take legitimate Fortran 77 statements as defined in the American National Standards Institute (Ansi) but it is well known that one Fortran 77 version is never quite the same as the next and that various slight differences can become annoyingly crucial when it comes to trying to convert from one machine's version of the language to the next.

On the new Micromainframe, Commodore has been able to go one step further, quite a feather in Commodore's cap, not because it proves how clever Commodore software people are, but because it proves what a good idea it is to go for a huge number of sales

connected to the big machine and a couple of dozen of them at a time would enter their code, edit it with the help of the big machine, compile it, and generally process it until it was ready to run. It was decided that a better way of doing this would be to have a separate computer for each student, on which they could do all the preliminary work and which would get it ready for the big mainframe to run. This would take a lot of the editing and compiling slog off the big machine and give it more time to actually run programs. It was also decided that as the PET was too small to run these languages, another machine would be needed.

There are two problems with the PET in this context. First, its internal processor, the 6502 chip, is able to work only on 8-bit bytes, and second, it can take only 32 kbytes of memory because of the way the Basic interpreter blots out half the memory addresses (yes, I know that's oversimplifying, but it covers most of the problem).

Waterloo University took a more modern processor, the Motorola 6809, which is very similar in many ways to the

6502 and which can handle 16-bit fields inside its engine, even though it looks like an ordinary 8-bit machine when plugged into an 8-bit system. This got plugged into the PET with its own 64 kbytes of memory and the PET was then fiddled with until it would sit quite happily on the end of a wire connected to the University's big IBM and DEC computers, doing all the right things to look like an ordinary terminal. Finally, the Waterloo compilers were converted to run on the new machine, so that exactly the same Fortran code would run on IBM, on DEC and on the new enhanced PET. All that had to be changed was the final stage of conversion from Fortran instructions to machine code, that is, the generation of assembly instructions. At this point, the assembly code is handed over to the assembler program, on whichever machine the program will run on — PET, DEC or IBM.

Jim Butterfield, the man who knows more about the PET than anyone else in the world, had high praise for this altered PET, the Micro-mainframe, when he spoke to the PET Show in June.

He didn't go bananas about the speed with which the compilers turn high level statements into machine code (though they are adequate) but he did say that 'your code will be very carefully checked for errors and you will be told in great detail what is wrong with it.' The result should be that the code is in useable form much quicker than a 'faster' compiler could get it, because picking up errors is the major hard work of compilation and re-writing.

All that, just from producing a machine cheap enough to sell a hundred models to one university. Eat your hearts out, Cromemco and RML.

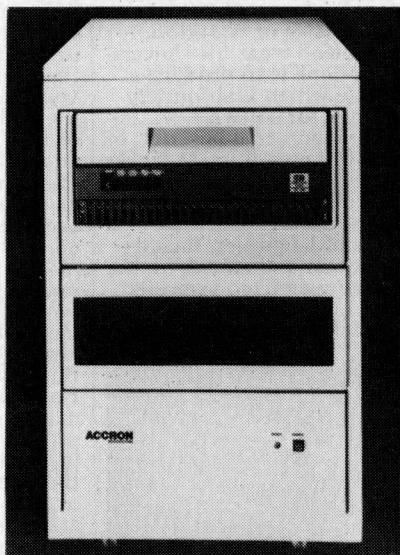
PET stunt

One thing the PET can't do by itself is run Wordstar. Well, there is a version written for it now (see below) but normally, Wordstar runs only on CP/M machines; only in June did PET get the necessary heart transplant to enable it to tackle CP/M programs.

The man who performed the surgery did it somewhat differently from the similar operation carried out by Microsoft on the Apple. Microsoft actually replaced the central Apple 6502 processor with a Z80 processor, plus a little logic and software inside the box. Derek Rowe, on the other hand, took his stunt box and shoved just over half a dozen memory chips into it.

His CP/M box, as he calls it, is in fact a £500 computer

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Use of the industry standard CP/M operating system means that a wealth of readily available, reasonably priced, system and application software will run on your ACCRON microsystem without any modification. Upgrade to multi-user, where simultaneous access of shared data files is required, is easily supported by the inclusion of simple file or record locking routines.

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ACCRON MPS-Series microsystems start at £2,400 for a single-user system with 2 double sided double density floppies. A typical 3-user system with 20-slot bus and a 10MB cartridge disk drive (5MB fixed/5MB cartridge costs £9,650). Add-on User Processors cost £900 and so you can grow on.

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with Z80 and 64 kbytes of memory, which can connect to the world through the PET's keyboard, disks and display. Just eight of the new Hitachi 64 kbit RAMs — which are chips holding 65,536 binary memory cells — and Bob's your uncle.

Bob, in this case, is Bob Gleadow, new Commodore boss in the UK. He hasn't made up his mind quite what to do, but at the PET Show, Bob was highly impressed by Rowe's work, and was planning to see if he could produce a PET with the CP/M box inside it, as a CP/M PET. If he does, he will pre-empt Commodore US, which is planning something similar.

Incidentally, Hitachi is currently offering a sample eight 64k RAMs for around £100, one set only per customer. Three years ago, £100 wouldn't have bought you a single 8 kbyte board from normal suppliers.

ZX microfair

ZX80 enthusiast Mike Johnston will be running a small show exclusively for Sinclair's ZX80 and ZX81 micros in central London at the end of September. Called the ZX Microfair, it will be held at the Central Hall, Westminster (opposite Westminster Abbey) on Saturday, 26 September, from 10.30 to 4pm. And admission is free!

Mike says he wants to provide a marketplace for people interested in the micro to meet the growing number of suppliers of software and peripherals — and there'll be the chance to get to know about educational and user groups. There will be a wide range of programs and books on offer, including games (inevitably 'Invaders') as well as more serious educational and personal finance software. Hardware add-ons now include a sound board and I/O ports. There are even rumours of hi-res graphics and floppy disks for the machines. For bargain hunters there'll be a bring and buy sale.

Philip Joy (ZX80 Chess) and Tim Hartnell (Interface) will also be there to answer your questions.

Details from Mike Johnston on 01-801 9172.

Over the top

Let's get one thing straight: what a micro is. A microcomputer is a cheap computer — cheap to buy, cheap to run and cheap to repair. Whether it has a microprocessor chip in it or not is quite beside the point; what matters is how many people can afford it.

By this standard, anybody offering a system costing £4000 and calling it a microcomputer is a gonzo and you believe them at your peril.

A system with one disk for storage and software loading plus a good screen, plus a full 64 kbytes of memory, plus a cheap but good printer should cost under £2000, preferably with a fair bit of operating software thrown in. Anybody operating much above that is going to have to pull prices down, or lose out to the people who can operate considerably below it — like Adam Osborne.

I know several perfectly acceptable computers that do cost more than £4000, such as the Computhink (Series 800) system sold by ACT in this country. But calling them 'sophisticated' microsystems is just a disguise for a price which lifts them out of the micro market.

At this point, enter Alistair Jacks. Illustrated below is a 'neat little French Z80 microcomputer made by Cii-Honeywell Bull,' which is 'the latest addition to the growing list of more than 30 machines that are now supported by MicroCobol.'

MicroCobol is a language which puts you at the mercy of a company called MPS. MPS is a company which used to be called CAP Microproducts, and has escaped from CAP (a large company purveying programmers to rich companies) to set up on its own. MicroCobol is a language that only MPS writes a program in (anybody else could, but they don't). Alistair Jacks assures me that the programs are very good indeed and his users agree with him. They include sales purchase and nominal ledger, invoicing, payroll and inventory control and three packages quite well spoken about, called AutoClerk, AutoIndex, and Autowriter. These are a filing system, an information retrieval system and a word processing system, respectively.

That's a nice list.

Alistair Jacks is very pleased with himself because once upon a time, you couldn't buy any one of them for much under £1000 and you had to buy his company's own operating system, BOS, first, for a £400 plus figure. Now, the price has come down: 'Any three of these, including the operating system, are available for around £1000 to £1500 — a price that puts them within the reach of most small users,' he claims.

This is known as fighting last year's battles. When CAP launched MicroCobol, this new price level would have saved it from heavy financial losses. Today, it is the same mistake brought up to date. Consider the PET, which is a successful micro in the UK, or the Apple which is a successful micro by any standard. Both have users to the point where there are more dealers and



Just to prove that hard disks using winchester technology do exist, Tim Keen has sent this pic of a Corvus drive specially designed to fit on the Apple II and III computers. This one offers five megabytes, but variants offering ten or 20 megabytes are available, up to a total of four drives and 80 megabytes. The five megabyte system 'is available with 12-user utility programs'. They include the ability to copy Corvus volumes to and from disks, and to switch between Basic languages and Pascal — quite a trick. Details on (0602) 583254.

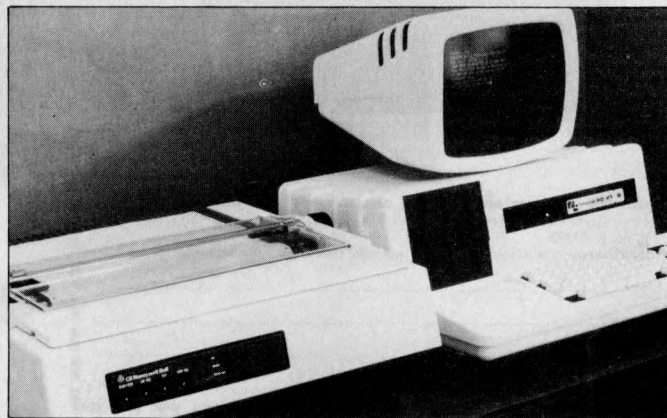
distributors for PET and Apple than there are users for MicroCobol. Yet even PET and Apple have acquired add-on boards which enable the machine to disguise itself as a CP/M system. MicroCobol systems, for the most part, are capable of running CP/M anyway and among the CP/M user group is enough free software to drown anything that MPS ever writes.

MPS software may be wonderful but it isn't micro software, because the software alone costs more than an Osborne 1 computer with five free packages of vastly more appeal — which means that if a MicroCobol system even started out at the same price as an Osborne then MicroCobol would more than double the price. Sadly, MicroCobol systems start out at double (or more) the price anyway and they won't link to Wordstar or Visicalc. The faithful few will continue to use MicroCobol, and like it, but they will all have to get CP/M too.

All in

Like the Silicon Office, Nebula is the 'first fully integrated business system for a microcomputer.' There have

been a couple of other integrated business systems, too, all the first, naturally. Nebula comes from ACT, Silicon office from the Bristol Software Factory. My suggestion is that you don't waste your time trying to work out which really is the first because they will all share that essential ingredient of the true pioneer — they will all be equally full of bugs. Avoid them all like the plague, until one day you meet a user and can find out what they do. Then, you ask this question of the user: 'If you are writing letters using the word processing bit, and somebody comes on the phone to you and says "where is last week's order, and I bet I'm not on the mailing list anyway, or at the very least you haven't recorded the pre-payment of an extra £2496.67 for the last order but two you rat, and by the way have you still got the address of that guy in California who you said could supply double cross-thread widgets to before July?"' — when this well-known creep asks you these questions, can you stop what you're doing, start up the sales ledger, then the mailing list, then the index search and



See 'Over the top'.

CHOOSING A COMPUTER MADE SIMPLE

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Made simple...

**FOR
EDUCATION**

Made simple...

ADVICE

Made simple...

**SERVICE
AND
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**IMPROVING
ON PET**

Not so simple

Choosing a computer is... Choosing a computer is more than just choosing a computer. That is, it's a lot more than just hardware. Mind you, PET stacks up very well when it comes to the computer itself. Because at Commodore we've been involved with microcomputers for over 20 years – in fact, many other manufacturers pay us the compliment of using our microchip for their own computers.

So, when you choose PET you know you have a microcomputer that everyone in the business admires and respects.

... choosing software... Our software programs live up to the quality of our computer. The range, from both Commodore and specialist suppliers, covers everything from word processing, stock control and payroll to accounting and information processing. As well as specialist applications for education and the sciences.

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... choosing value... Our computers start at under £200 and go through to £3000 – which will buy you a complete business system. The extent of our range makes sure that you'll easily be able to choose the right computer for your individual needs.

... choosing a dealer... As you can see, you do get nationwide dealer back-up with Commodore.

What's more, many of our dealers have specific expertise – which means they can advise on anything from business systems to specialist technical applications. So, if your particular problem is of a highly specialised nature, it may be best to contact our Information Department direct.

They will then recommend the dealers who understand – and who speak your kind of language.

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Send to: Commodore Information Services, P.O. Box 109, Baker Street, High Wycombe.
Tel: Slough 79292.

I'd like to know how a Commodore PET will make choosing a computer simple for me.

Name.....

Company.....

Address.....

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24 PC1

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W13, 01-579 5845
Byteshop Computerland
NW1, 01-387 0505
Capital Computer Systems Ltd
W1, 01-636 3863 & 637 5551
Centralex - London Ltd
SE13, 01-318 4213-7
Chromasonic Electronics
N19, 01-263 9493/9495
Healey Management Services Ltd
E1, 01-247 2858/3149
Home and Business Computers
E12, 01-472 5107
Logic Box Ltd
SW1, 01-222 1122/5492
Merchant Systems Limited
EC4, 01-583 6774
Meycleian Ltd
EC4, 01-236 2000
Micro Computer Centre
N14, 01-882 5104
Micro Computer Centre
SW14, 01-878 7044-7
Sumlock Bondain Ltd
EC1, 01-250 0505
The Computer Shop (City) Ltd
EC1, 01-628 3531

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ALTON, 84517
The Computer Shop (Banbury) Ltd
BANBURY, 3477
H.S.V. Ltd
BASINGSTOKE, 62444
M.M.S. Limited
BEDFORD, 40601/2
Bracknell Computers
BRACKNELL, 52929
D.D.M. Direct Data Marketing Ltd
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Amplicon Micro Systems Limited
BRIGHTON, 562163 & 608331
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Wego Computers Ltd
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Bromwall Data Services Ltd
HATFIELD, 60980/67111
Alpha Business Systems
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ILFORD, 01-554 3344
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KETERING, 520910
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LUTON, 426887/416892
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COVENTRY, 20246
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LEICESTER, 22255
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Betos (Systems) Ltd
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GRIMSBY, 40568
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HULL, 23146
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Computer Centre (Sheffield) Ltd
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SLEAFORD, 305637
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YORK, 52995

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GATESHEAD, 774540
Dyson Instruments
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Key Computer Services Ltd
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Intex Datalog Ltd
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MANCHESTER, 061-832 4761
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MANCHESTER, 061-872 4682
Executive Reprographic Ltd
MANCHESTER, 061-228 1637
Professional Computer Services Ltd
OLDHAM, 061-624 4065
Catlands Information Systems Ltd
STOCKPORT, 061-477 6699
Catlands Information Systems Ltd
WILMSLOW, 527166

LIVERPOOL

Stack Computer Services Ltd
BOOTLE, 051-933 5511
Aughton Microsystems
KIRKBY, 051-548 7788
Rockcliff Micro Computers
LIVERPOOL, 051-521 5830
The Computer Shop (Southport) Ltd
SOUTHPORT, 77783

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B & B (Computers) Limited
BOLTON, 26644
Tharstern Limited
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WEST COUNTRY

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TRURO, 71626

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Sumlock Tabdown Ltd
CARDIFF, 41361
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BEAULY, 046-371 2774
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GLASGOW, 041-221 7409
Gate Microsystems Limited
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Robox Ltd
GLASGOW, 041-221 8413/4
Ayrshire Office Computers
KILMARNOCK, 42972

NORTHERN IRELAND

Northern Ireland Computer Centre Limited
HOLYWOOD, (02317) 6548

retrieval, and finally ring off and carry on your letter where you were interrupted?'

This is the answer you will get from the user: 'No.'

'Then', you will say triumphantly, 'then it is not a truly integrated business system and you were a sucker to buy one.'

ACT proudly states that it has developed its software from the brilliant software it produced for its bureau business. It must be good, because during the past two years 'ACT has spent nearly £½ million on the development of this software.'

Funny; in the same announcement Roger Foster shows exactly the same inability to draw logical conclusions, when he says, 'Most of you will be aware that ACT is the only British Computer Company other than ICL who have a full listing on the stock exchange.' Next he'll be saying that, like British Leyland, he's based in the Midlands, and like Logabax was, he's involved in the 'upper end' of the micro market, and like Scan Data, he's exclusive UK distributor for something. .

Super fun

Users of Superboards and the UK101 imitation tend to be people who like using volt meters and screwdrivers — so offering these people a set of boards which will connect their systems to everything in the house or laboratory is probably a sensible move.

For a total of under £100, Technomatic has produced these three boards which interface Superboard range machines to toys like games paddles, equipment like analogue measurement units, or to counting and timing circuits.

All the applications they've thought of are covered in a 50-page booklet, plus a C60 audio cassette containing full program support (27 programs).

Details on 01-452 1500 or 01-450 6597.

Apple crush

You may watch an Apple user load a disk, curse, and

say something like 'bloody 35 track system' and throw it in a corner as if it hadn't cost him a tenner to rip off. He will possibly be a user of 40 track and 70 track new/disk drives which add on the Apple, made by Micro-Sci at £343 through Computopia (offering 14 percent more capacity than the standard Apple drives) or £484 for the larger version offering twice as much as Apple. On the blurb, it refers happily to 'Genuine COMPATIBILITY' by which they obviously mean that Applesoft and CP/M and Pascal programs which uses Apple disk for data storage can use these. But if you think you can plug in your ordinary 35-track Apple disk and read it on these drives, you must have a very special concept of 'compatibility'. Details on (0525) 376600.

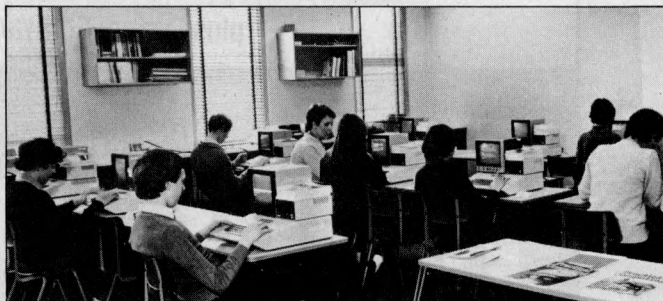
Incomplete Iris

Looking through the ads in this issue, add the price of the SuperBrain to the price of a Diablo printer and subtract the result from £4750. There, you know the price of Iris, an incomplete records information system plus word processing software which KGB sells with 12 months' warranty on a SuperBrain. It was written for a partnership of nine accountants with six offices and will handle 4000 postings for each set of accounts. Details on 01-398 7531.

Programmer database

The explosion that kept you awake the other night and which you never found out what happened, was caused (it says here) by a registration system for professional software writers.

It was organised originally in Bradford by RAM Computer Services, and has 'exploded into a countrywide operation'. It's a computer dating service to match suitable programmers to companies needing software.



This picture should serve as encouragement to the idle. It shows a classroom in Edensor High School, Stoke-on-Trent, where ten Apple systems with disks are being used in a classroom. They were supplied to Staffordshire's education authority by Kratos Instem; details on Stone 812131.

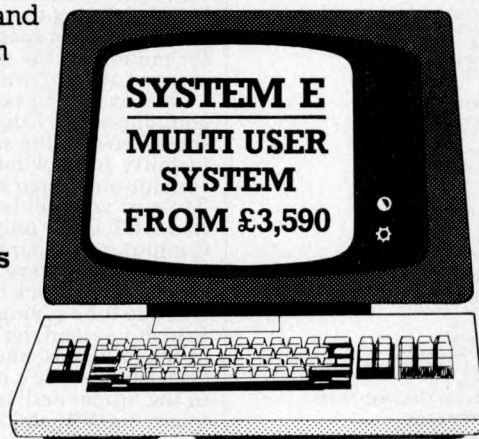
Which Computer?

Just a few tasks a microcomputer could be organising for your company, division or department:-

Businessmen and professional people alike can rid themselves of day-to-day problems and increased workload with a microcomputer.

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- Architects
- Engineers
- Chemists
- Farmers
- Bankers
- Teachers

to name
but a few



- Integrated Accounts
- Sales Ledger
- Purchase Ledger
- Nominal Ledger
- Sales Forecasting
- Stock Control
- Job Costing
- Estimating
- Payroll
- Word Processing

(automatic compilation, editing and production of repetitive letters and documents).



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Basic computer including screen & keyboard

SYSTEM B

As 'A', plus floppy disk drive(s) and matrix printer for small business user.

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As 'B', but quality printer for word processing instead.

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As 'B', plus hard disk for up to 5,000,000 bytes on line.

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Johnson

microcomputers

Johnson House, 75-79 Park Street,
Camberley Surrey. Telephone 0276 20446

48 Gloucester Road, Bristol. Telephone 0272 422061

148 Cowley Road, Oxford. Telephone 0865 721461

To join, you need only be a freelance software writer who can pass a vetting procedure by RAM's own programmers. Then they pass you on to the company whose profile matches your own most closely, take their commission and disappear like a fairy godmother. Details on (0274) 391166.

VIC gold

The first program for the new Commodore VIC to be announced to this column is the £16 game called 'Gold Rush' from Mr Micro in Manchester.

The first person to beat the game has to notify Mr Micro and will get a real bag of real 22 carat gold (I don't know how big a bag, but it won't be too heavy to post) as prize. To make sure the contest is fair, all orders received by Mr Micro before 26 August will be sent off together. Oh, dear, we seem to have missed the date a bit! And none of you has a VIC yet? Never mind, we'll send the gold to a good cause. Details: Freepost, Swinton, Manchester M27 1BX.

PET Jaws

How Mator can announce a device called the 'Shark' as 'the first in the world to give personal computers access to winchester technology' without anticipating being called sharks themselves, is beyond me. It's well over a year since I first saw Tim Keen displaying the big Corvus drive on an Apple, and that's winchester storage. The shark goes on a PET (among other things) at £3250; details on 0273 720451, and keep your hands in your pockets.



It is nice to see a new company distributing micros under the name Ai (UK) and it would be nice to welcome two new machines which the company says it is introducing to the UK, called the Ai Microcomputers ABC 24 and ABC 26. But in fact they are old friends. I think they used to be the Sattco ABC range, and they were sold by Sun. Now Sun is hoping to be a dealer. We've done the Benchtest in our April issue. Details about the new distributor on an address only: Ai Micros, Thames Industrial Estate, Marlow, Bucks.

It takes two

What I like about the Shattered Alliance (a computer game) even before I play it is the fact that two people can play each other. There are many good games for one man and his micro, but just occasionally a friend calls and they seem to find displays of virtuosity a little tiresome.

This one lets one play the computer but it also lets two play each other with the machine doing the 'book-keeping', including keeping track of magic spells, battles, fights and so on. You need \$60, a 48 kbyte Apple, and Applesoft in ROM as well as one disk drive; details from Strategic Simulations in California on (415) 964 1353.

Multiple micros

Our National Physical Laboratory rather thinks it has achieved one of the oldest dreams of the microcomputer era: a system which can be made bigger and bigger by merely adding in new micro-processor chips.

This is a very strange concept to most users because, on the face of it, the idea is nonsense. The idea is that you start out by writing a program, run it on your micro and find it's too slow. So you reach into the cabinet with another chip and find it's still a bit too slow — so you reach in with another and it's fast enough.

The idea started off as a theoretical machine called Demos, developed by NPL and a BP subsidiary called Scicon.

Together they had devised a theoretical system which would allow this sort of net-

work — called closely coupled — to be built up into a very powerful system indeed, with 250 micros inside it. And these were going to be bigger micros than the normal Z80 or 6502 chips; they were going to be things at least the size of the Intel 8086.

Now the NPL has announced that the necessary hardware — a fast ring which can transfer data from processor to processor — to run Demos is available.

It will also do other things. 'The NPL ring is the ideal interconnection mechanism for localised or distributed systems requiring high reliability and performance and/or a guaranteed worst-case response time,' reports Dr Vaswani from Teddington.

At this stage, it isn't available as a saleable product. What Vaswani wants is for interested companies to get in touch, with an eye to exploiting this invention.

He is on 01-977 3222.

Winnie warning

A warning from a supplier of power supplies to anyone planning to put a new hard Winchester disk drive into a system: these big data storage drives have to spin very fast. The magnetic heads that read the data have to be very close to the surface of the disk, they float on a very thin layer of air and, if they slow down, the heads crash into the disk. This means that they have to start up very fast, or the heads scrape when starting up. In fact, they start up so fast that the power supply needs to be able to supply 7A to power the motor. Such a supply is available, needless to add, from the company purveying the warning: details from Dialogue Marketing on 06285 29222.

Online show

Our apologies for the printer's gremlin which slipped into 'Diary Data' and put in the wrong dates for the Online Show at Wembley last month.

Comp winner

The winner of our Micro-digital competition was Mr J Haines of London. He'll be collecting his £1000 prize at the PCW show.

SuperBrain add-ons

Dealers in the SuperBrain are likely to be delighted to hear of a new diagnostic disk supplied by Intertec. It is designed 'to aid in servicing of their complete line of

products'.

According to an innocently worded statement by the company (which we reported last month had been accused of supplying up to 80 per cent faulty machines to the UK), 'We have received dozens of requests for this diagnostic tool'. I bet.

More positive news: the company has also produced a special cable which allows the SuperBrain to be connected to the Compustar ten megabyte hard disk storage system. With the cable is a disk full of software, designed to generate new operating systems which allow the machine and disk to talk sense to each other.

Finally, an upgrade to the disk operating system has been announced, providing a great deal to the user who wants to make the system jump through hoops — special features include a key repeat if held down, and a type-ahead for fast keyboard operators so that letters aren't lost. There is also a time of day feature, a date feature, and a feature which allows 'limited' synchronous communication under IBM's bisynch protocol. You can also change the numeric keypad keys so that they look like other keys, and if you put your own caps on the keys these can serve specific functions (some people already do this to turn the machine into a dedicated word processor).

Details from Intertec in the US on (803) 798 9100.

Anadex announces

Anadex printers are now available through Apple distributor Microsense; and there are now three new printers due to appear in this country early next year.

One of the new printers is a rudimentary word processor, with keyboard included plus a 40-character single line display to allow editing prior to transmission. A new range with prices starting at £700 is planned, specifically for UK and European markets, this month.

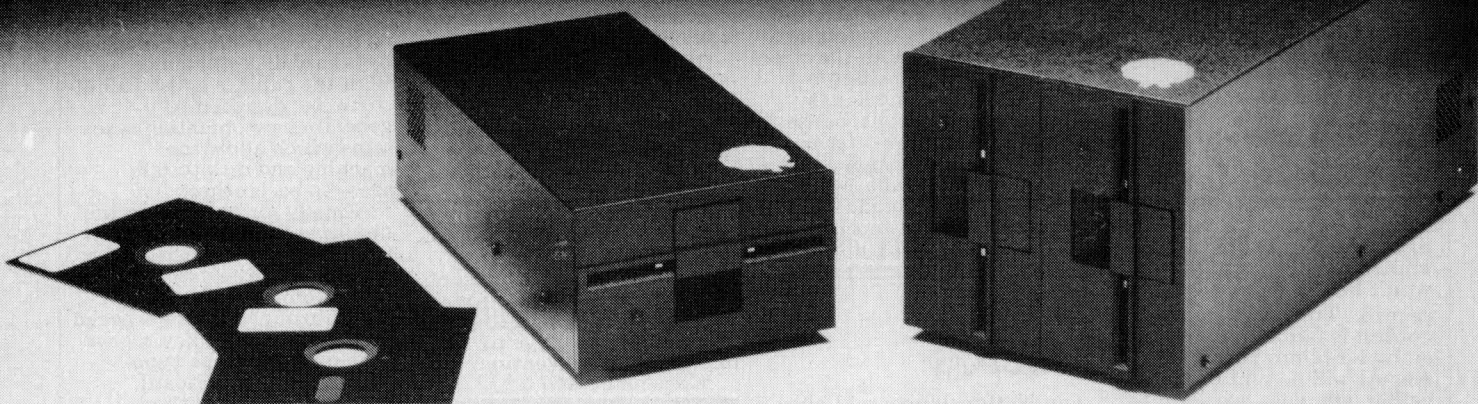
Details on this on Guildford (0483) 503776.

Budget printer

A printer for £200, with Centronics interface, from Cricket Peripherals, is, alas, a thermal printer. This makes it quiet but, compared (for example) with Acorn's new printer, which plugs in with a word processor chip for only £30 more, it should either be cheaper or a lot faster. It also needs a £35 interface. Details, nonetheless, from 92 London Road, Knebworth, Herts.

APPLE II COMPATIBLE DISC DRIVES

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MAGNETICS**



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Purchase two units and 10 Dysan diskettes will be provided free — worth £26.00

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TRS 80/VIDEO GENIE DISC DRIVES

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Move up market with Tandon Specifications, Double Density capability, 40 or 80 tracks and step rates as low as 3m secs track to track. Also interfaces to Superbrains, Horizons, Zenith, SWTP, Heathkit, etc.

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Apple
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Eye strain

If anybody is going to find problems in the effect of video displays on eyesight, it will be the union ASTMS, which represents the sort of people who use them. And it has to be said that ASTMS has, in its report on the problem, not offered conclusive evidence that videos are necessarily a hazard to eyesight.

But it has concluded fairly forcibly that poor videos definitely are, especially to people with eye defects that don't show up when they are walking around. And TV screens are definitely poor videos, because they have poor definition, they tend to shake, shimmer, and go out of focus, and not be in the right position for comfortable neck positions. Be warned; get the report on 0279 58111.

Mini micro

Anybody needing proof that a machine with a micro in it isn't a microcomputer should examine Systime's latest minicomputer. Systime makes a Series 5000 mini which it sells successfully, if less profitably than it might. Inside this mini is a processor called the PDP 11/34 made by DEC, and it is one of the world's most successful minis.

Now, Systime has grabbed the big Intel microprocessor, the 8086. Instead of turning it into a networking micro, it has given it a version of Basic that is virtually identical to the Basic on the DEC mini and an operating system that duplicates most of the commands of the DEC operating system. It sells for a lot less than the DEC machine but you do need £6000 to buy the cheapest model. A nice machine, I suppose, but not for single users. Details on 0532 702211, and don't bother saying you're married (ha ha).

Have wheels, will compute

One advantage of today's microcomputers is that you can carry them around, not just from one room to another but, if you're an accountant, for instance, from one client to another.

This, though, has its disadvantages, too, as chartered accountant Denis Fuller discovered when he and his colleagues decided to take their machine down to Devon for some on-site work. First, on the journey down, they had to take it in turns to hold the computer, to prevent its flying off the back seat onto the driver's lap. When they arrived, they had to carry it across a crowded, untidy factory floor and up some stairs to the boss's office. The final straw was that the boss's desk was buried under a mountain of paper. Clearly, thought Fuller, there had to be a better way of carrying a computer around; the answer he came up with was a mobile office/computer room.

Now, although the motor trade has come up with some pretty ingenious special-purpose vehicles in its time, nobody has actually produced a mobile computer room, so Fuller had to start from scratch, converting a 35 cwt Transit van to house the computer (see photo). This completed successfully, he decided that others might also want mobile computing, so he's set up a company to produce the conversions, under the name Wheeloffice. If you need mobile computing power, contact Fuller on Chertsey 66646.

It strikes me that this could get out of hand; about the only thing missing from those monstrous American mobile mansions is a home computer — any bets on how long it'll be before computers come as standard fittings along with the shower, air conditioner and fitted carpets?



The Wheeloffice — see 'Have wheels, will compute'.

Down on the farm

Fertiliser rarely gets a mention in these pages, but it's getting one now.

Making up mixtures of fertilisers is, it seems, rather complicated, difficult enough at least to merit computer control. The company which has achieved this is Howes Electrical & Automation

Service, which has linked up a Sharp MZ-80K to an incomprehensible (to me) array of equipment which mixes up the, er, ingredients and feeds samples to a group of spectro analysers; the computer samples these as a check of how the mix is going.

If you're up to your neck in improperly mixed fertiliser, give Howes a ring on Lincoln 32379/791088.



A new, improved version of the Softy EPROM programmer/development system has been launched by Barry Savage's company, Dataman Designs. As the pic shows, Softy 2 is a lot neater than the original Softy, but what you can't see just by looking is that the new one handles 2516/2716/2532/2732 single-rail (5V) EPROMs. Softy 1, which handles 2708 and 2716 three-rail EPROMs, is still available, by the way. More on 0305 68066.

Clive's Computer

By TED RICHARDS



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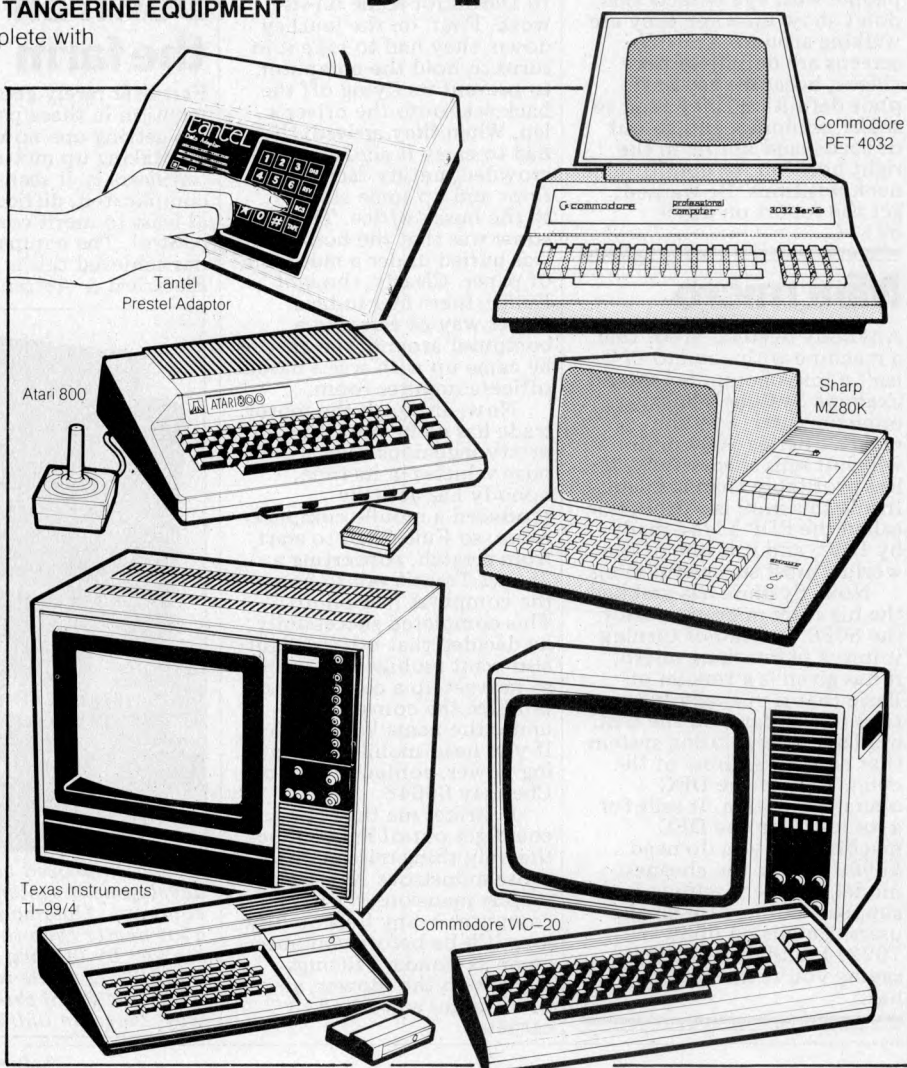
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NEWS

ComputerTown UK! is a nationwide network of voluntary computer literacy centres. All letters should be addressed to CTUK! c/o 14 Rathbone Place, London W1P 1DE

ComputerTown UK! Comes of Age

Twenty-one today, twenty-one today!! That's how many ComputerTowns are now up and running. ComputerTown Guidelines has now been printed at phenomenal expense (about 20p per copy) and we'll be sending them out free from now on to all new enquirers about ComputerTown on receipt of an SAE. If you're one of those five or six unlucky people who received a tatty photocopy of a computer printed version then I'll send you a nicely printed one if you need it. Finally, before getting to the real news this month (ie, yours) I hope we'll be seeing you at the PCW show. ComputerTown will have a stand down among the computer clubs on the lower floor.

Ted Broadhead tells us that ComputerTown Leeds is up and running with the help of the West Yorkshire Micro-computer Group and Philip Clark. Four local schools provided a number of teachers and around 30 pupils who turned up to the first session to use seven microcomputers. The teachers and assorted CT volunteers ended up in a huddle and it was decided that one of the first responsibilities of CT, after ensuring that normal sessions are run, will be to train the teachers. Anyone wanting to contact Ted will find him at 27 Cardinal Road, Leeds LS11 8EY.

Vernon Quaintance is the man behind the newly-formed Norbury ComputerTown but I've not heard much news yet — perhaps that'll come in next month. Thanks to Sue Eisenbach and Chris Sadler who kindly donated two VDUs to Vernon for use in ComputerTown. Vernon lives at 50 Beatrice Avenue, Norbury, SW16 4UN, telephone 01-764 6556.

Talking of 'Vernons', Vernon Gifford recently gave a talk and participated in a subsequent debate at North London Polytechnic on the subject of 'Community Computing'. Apparently the room was packed with all sorts of influential people, many of them in a position to spread the ComputerTown word.

We received a couple of letters this month from people who look as if they're close to setting up their own CTs. They are Roger Saunders from Hemel Hempstead and John Bretton from Matlock. Anyone who'd like to join in should contact Roger at 14 St Nicholas' Mount, Hemel Hempstead, Herts, HP1 2BB. John writes from Matlock College of Higher Education where he has access to a couple of PETs, an RML 380Z and a number of ZX80s and '81s. John's address is 'Woodlands', Wellington Street, Matlock, Derbys, DE4 3GS. Hope to hear more news

from you both soon.

Five people wrote to say that they'd like to start or help start a CT in their area. Nicholas Overend is 13 and his address is 27 Burleigh Road, Addlestone, Surrey KT15 1PN. Dave Silcock can be found at 6 Newport Road, Slough, Berks. Peter Bamfield is willing to have a go at setting up a 'Town in the Brighton area despite being partially sighted and disabled. He reckons that, with three computer shops in town, someone could be persuaded to loan equipment. Write to Flat 5, 24 Windlesham Gardens, Brighton, East Sussex BN1 3AJ, tel 0273 737884. John Maunsell is our fourth volunteer and he lives at 50 Avoca Road, London SW17 8SL; our fifth is John Still of Wembley. Since he's up the Harrow end of Wembley, I've put him in touch with Susan Kelly at Harrow Civic Centre Reference Library. John has got a PET with a printer plus something like 80 games programs. Surely we'll be hearing about CT Harrow before very long.

Nick Smith, who is the creator of Sterling Mouse, recently won a Sharp MZ-80K computer in a micromouse maze competition held in Paris. Being a kind-hearted soul he now lets CT Eastcote borrow the machine every fortnight. Keith Lawrence of CT Enfield has written a program for the TRS-80 which demonstrates the machine's features and facilities. Keith has kindly made this program available to any bona fide ComputerTown in the UK, provided it is not passed on to third parties for commercial or similar exploitation. CT Enfield is gradually accumulating hardware with the donation of a ZX81 from Woolcott and Co Ltd, and a television set from (I think) Keith Lawrence. Wonderful news — other 'Towns please note. I think that CT Enfield is a good example of what can happen when a ComputerTown and a computer club get together. The 'Town feeds the club with new members and ComputerTown volunteers can be found in the club. That's symbiosis for you. It might be worthwhile for all clubless 'Towns and all 'Townless clubs to reflect on this.

Philip Joy has written from ComputerTown Romford with a couple of unusual offers. He is prepared to write a program to your supplied specification, provided that it has some use in a ComputerTown. He said he won't write long and complex programs which would take ages. Only bona fide ComputerTowns need apply and they should send Philip a tape, a full specification and an SAE. Needless to

say, the program can only be used in ComputerTown, — it mustn't be sold or anything. I'm not sure what machine Philip is writing for but I suspect it to be a ZX80. It could also be a Video Genie. Philip will also be providing a program which will teach Basic with no outside help. You can contact this amazing person at 130 Rush Green Road, Romford, Essex RM7 0QA.

Had a flurry of letters and things from the DoI and the Information Technology Year people. Minister Kenneth Baker wants to visit a CT and, if it happens, it looks like being one of the North East 'Towns. IT Year thinks we should maintain a low profile during the 1982 jollifications but they offered to help out in any way they could. I'm still a bit puzzled by these people and, I suspect, they're very puzzled by this strange network of autonomous voluntary groups who have neither political nor financial axes to grind.

I've mentioned this one before but there's no harm in mentioning it again: there are people around who are trying to make a name for themselves and they see ComputerTown as a route to instant credibility. Be very careful before allowing people to use the ComputerTown name. If you find yourself in a situation where you're not sure what to do then please contact us and we'll ring you back after work or at the weekend for a chat. We only need ComputerTown associated with one tacky enterprise and it will destroy everything we've built so far. If in doubt, don't. If you find this paragraph puzzling, don't worry. When the situation arises you'll recognise it and you'll understand what I'm driving at.

J R Ault noticed our mention of computer insurance recently and wrote to say that his company offers insurance policies for computer equipment. Write to him at J Sydney Ault Ltd, West Bromwich B70 8SD tel 021-553 4791.

Finally, here is this month's list of enquirer's towns: Lancaster; London WC1 (2); Rushden, Northants; Newcastle (2); Liverpool; Thornton, Leics; Ware, Herts; Skelmersdale, Lancs; Oxshott; Houghton, Hunts; Winchester; Witton Gilbert, Co Durham; Epsom and Oxford.

Thank you all very much for your interest in Computer Town. Keep up the good work and do write in with your news. All enquiries must be accompanied by an SAE with one edge of at least 9in. Please don't try to phone us at the PCW offices because ComputerTown is entirely a spare-time project.

PCW welcomes correspondence from its readers but we must warn that it tends to be one way! Please be as brief as possible and add 'not for publication' if your letter is to be kept private. Please note that we are unable to give advice about the purchase of computers or other hardware/software -- these questions must be addressed to Sheridan Williams (see 'Computer Answers' page). Address letters to: 'Communications', Personal Computer World, 14 Rathbone Place, London W1P 1DE.

Bouquets...

It is not often that anyone writes to PCW in praise of a software house. I am writing to commend one such firm, A J Harding (Molimerx) of Bexhill-on-Sea, which supplies software for the TRS80.

I was prompted to write this letter by a recent incident when I had cause to return a cassette. My assembler tape was faulty and, after a while, it ceased to load. I returned the tape with a covering letter on Tuesday. On Thursday of the same week the tape came back re-recorded on a new cassette. Not only did the tape work properly, it had also come back by return of post!

This shows one of the most important assets of a good software house: a back-up service. Harding's service is second to none and makes problems much more pleasant to bear. The standard set by Harding's is an example to all. Harding's is the best firm I have ever dealt with and I wouldn't hesitate in recommending them to anybody. G M Taylor, Leeds

...and brickbats

I read with very great interest the recent 'Benchtest' report of the Acorn Econet which gave me a lot of information I had not been able to get from Acorn.

Let me explain. I am a teacher in the fortunate position of working for a far-sighted authority willing to spend money on bringing computers into schools. As a result my school has had two micros, disks and printer for about a year now. Enough experience of the difficulties of incorporating the computer into the life of the school has been accumulated for us to be thinking of the next step. Those actively interested in computers believe that we must move towards some kind of network. It is hardly surprising that we should be attracted to the Econet. Low cost, the capacity for a large number of stations, endorsed by the DoI and able to operate over fairly large distances -- surely it must be a winner?

Having read the advertising given away free at an exhibition and at the local University Open Day there were one or two points to clarify, such as the price of a typical installation which might suit us. I phoned Acorn. 'Oh Econet: you want Mr ... I'll get him

to ring you back.' A week passes. I telephone again. 'Mr. ...? He's not here at the moment. Try him on. ...' -- and I am given another number. I try, with the same result. I try the next number. Mr. ... is in a meeting. I get a promise that he will ring me back next day. By lunch time I have heard nothing so I try again. After my lunch I try again. Mr. ... is still at lunch but he will definitely phone me back after school. Excited now I wait for his call. And I wait. Ah well, I'll phone him. Success! He's there (couldn't find my STD code). I tell him what I want and he is very helpful, he is going to send me the specifications and the prices of some installations Acorn has made recently, plus the names of some schools which have Econet in an adjacent Authority. A week passes and I search my mail each day. Nothing so I phone again and receive a promise that I will get the information the Mr. ... promised. I'm still waiting after nearly three more weeks.

Don't think that Acorn are alone with this sort of attitude to queries. Try asking Commodore about Comal. I did in February: after all, it could be important to know if the compiler will fit into any new PETs we might buy and still leave room for useful programs. A telephone call to them revealed that my letter had just vanished without trace. The dealers I quizzed fell into two categories. They had heard of Comal but knew nothing about it or they had never heard of it and knew nothing about it. And that was last Friday, with one dealer.

After experiences like this, one can be forgiven for thinking that all that some companies want to do is sit back and complain about teachers stealing their often rather poor and overpriced educational software by unauthorised copying, confident that those same teachers will be so bedazzled by having a computer in their school that they will happily spend money as if it is going out of fashion. Fortunately I have had happier experiences too, otherwise I might get cynical.

Potentially the education market is very large but it will saturate very quickly if my experiences are repeated throughout the country.

The experiences are mine, the views are mine; they should not be associated with my school or my education authority. But ultimately it is people like me who will use computers in the classroom and decide if we can

spend our money more effectively. Les May, Rochdale, Lancs.

Bloggs agrees

How very true Malcolm Peltu's remarks are on the ZX81 Manual.

I am one of the thousands of Joe Bloggs he refers to, with perhaps a slight advantage over our Joe as I do program a Casio fx502p and a TI59 for simple mathematical work.

Back to the ZX81 manual; I have religiously worked my way through the manual chapter by chapter and although reasonably successful, I must make the following comments: Chapter 5, Functions; explanations totally inadequate. The attempt to explain the function RND, RAND is quite confusing; Chapter 18, From exercise 6 onwards, confusion prevailed, particularly the section on page 122; Chapter 19. The explanation of the function INKEY\$ is not particularly clear, nor could I get exercise 2 to work on the space and New Line steps;

Chapter 21. Substrings; I am completely confused and unable to understand, as with Chapter 22 on Arrays; The remaining chapters were certainly not written for the Joe Bloggs of this world. My main criticism as one who learns by example is the total lack of exercises with answers and explanations as to where, why and how one would use such functions as LEN, VAL, ATN, SGN, INKEY\$ in programming.

To sum up I have had my ZX81 for some weeks now and have spent several hours everyday on it, often sitting up burning the midnight oil, much to the annoyance of the family. I feel fairly confident with my ZX81 and am able to write some simple programs and do graphics, to the limitations of the 1k basic unit (have ordered the 16k expansion). However, I don't feel one could do what the general press advertisements allegedly claim one should be able to do using the existing manual only. D Stangroom, Potters Bar Herts.

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Bloggs bites back

I was most surprised to read in 'Bookfare' (July 81 PCW) the article criticising the ZX81 handbook. I received my

ZX81 two weeks ago and have been most impressed by the clarity of the explanations and examples.

If Joe Bloggs does not understand basic mathematical expressions he will not be able to program a computer anyway and should not expect this computer handbook to teach him mathematics.

This Gladys Bloggs was completely mystified, not by the manual but by the ZX81 Sketch Pad program printed on p156:

1. The use of £ rather than \$ is due presumably to patriotism;
2. Slow (line 10) need not be used -- this is the normal mode;
3. X and Y are undefined variables and therefore cause the program to crash;
4. End (line 100) is not a command recognised by the ZX81.

Gladys Bloggs alias Pauline Banks, Egremont, Cumbria

Digico viewpoint

I have read your article about Digico's micro processor launch several times and felt that it gives a completely inaccurate picture of both the company and the product.

You describe Digico as living in the doldrums and struggling from crisis to crisis. However, the truth is that the last four years have been extremely exciting and profitable and have put Digico in the top league of percentage profit earners in the UK computer industry. Our last three years' results were £240,000, £222,000, and £300,000 net profit. We have had 30 percent compound growth during this period and despite quadrupling our turnover in the last four years we currently have no borrowings, money invested in the markets, and a very strong balance sheet.

We have in recent years won a Design Council Award for the technical excellence of our product and won the Institute of Marketing's national award in 1979. During the last two years we have formed a holding company and sister organisations in computer supplies, computer rentals, computer field maintenance, and computer programming. We have launched the lowest cost paged mini computer available in this country, a one million instruction per second micro, 300 megabyte disk drives, and our

latest is the twin Z80 micro processor (sic). Remember, all of this R&D has been absorbed within the profit figures mentioned above.)

I think all this illustrates that your description of the company was less than accurate. It would now be useful to look at your comments on the Prince micro system.

We believe there is more to a computer system (micro or mini) than just the hardware and software. We believe that if an organisation intends to use a computer system for a serious job (whether this be accounting, production control, research, data storage, etc), then the user needs a guarantee that:

1. His system will be offered maintenance for at least seven years;
2. There will be local support available for his product;
3. The manufacturer should be available to give training where necessary;
4. The computer is given the same kind of QC procedures as a full-scale mini.

Many of the 'bottom end' micro systems available do not meet these criteria. There are many micro processors which are imported from California by small organisations where both the importer and manufacturer may well be financially unstable. This is a risky purchase.

Of course there are first class companies producing quality hardware and giving good support. These systems do tend to be expensive, however, and we believe that the Digico Prince system will offer all of the benefits listed above, though our price is little more than some of the hobby machines. We are even offering a 'Minimum Interruption Plan' maintenance system, where we will exchange your complete unit in order to keep your system running.

Finally, the Prince can obviously work alone and is a powerful micro system. But it also can integrate within our mini computer range as an intelligent terminal or remote mode. When connected to any of our minis it has available to it all of the facilities of the larger system without any restriction. We therefore believe we offer a quality product, with powerful processing capabilities, with maintenance by the manufacturer, a seven year guarantee of life, a wide range of software, and a hobby machine price. This surely has got to be a good thing for our industry. Kenneth Atkinson, Digico, Letchworth, Herts.

Guy replies...

Mr Atkinson is possibly right to read a touch of scepticism into my report on the launch of the Digico Prince. He's equally right to imply that,

sometimes, there have been reports on new American products where I should have been equally sceptical — or perhaps more so.

Nonetheless, I suggest that readers might turn to page 42 of the 'chimp' issue, June 1981, and see if the general tone is really as scathing as Digico seems to think. I notice that I used terms like 'hooray' and 'encouragingly' (twice), and referred to Digico's past problems as 'history' — and even suggested that many of these past problems had not been the company's fault, but caused by government non-support.

Where I singled Digico out for scorn was in the bland assumption that minis are 'better' than micros, based on their past in the mini market. It may be that mini multi-terminal software (things like MP/M) which fall over because the hardware isn't designed to hold them up — but single user software is so much more inherently reliable and powerful, that today's micros, despised as 'hobbyist' systems by Digico, really are miles more sophisticated to the user, and for his purpose.

As for quoting Design Centre awards: well, if Digico could give me a sample of every product that has ever appeared in the Design Centre but which has been withdrawn when the manufacturer went bust, I'd agree that their profits were phenomenal. Unless the machine is a knockout, it's distribution that makes it or breaks it, which is why I was so pleased to report that 'a network of dealers' was planned. What more do they want? A written guarantee that everybody in the company loves their fellow men, doesn't copy cassettes, and will keep the company going even if it means mortgaging their houses to repair customers' kit?

Memory saver

I have been considering the problems involved with memory capacity and graphics on the ZX80/81. I came up with the following solution:

Write a short program which will display the Game Board. (For example: Meteors for skulking monsters and boxes for scores, fuel supply etc.). Run this and then, using China-Graph markers, draw over the display to produce a copy on the glass front. Next load the main program which will contain the instructions just for playing moves, scoring etc. After the Game has been run the China-Graph can easily be removed using

a paper cloth. If one uses different colours good effects can be obtained. (Markers can be found in any good stationers.)

Daniel Larah, Manchester.

Protection points II

I was pleased to see the publication of my letter entitled 'Protection Points' in your July issue; however, I was disturbed to see that an error has crept into the fourth paragraph where a *not* has been missed out.

An independently conceived second program which embodies the idea of a copyright protected first program is *not* an infringement of the copyright in that first program.

R J Hart, Liverpool

ZX81 tape tip

I thought you might be interested in the following information regarding loading of programs from tape into the Sinclair ZX81. I am also writing to Science of Cambridge.

When my ZX81 first arrived, I experienced problems loading trial programs from cassette. However, these problems disappeared for a time and all was well. I put them down to not giving the tape time to pick up speed before saving.

The same problem recently recurred and after hours of hair-tearing effort I finally discovered the cause.

The problem was that the 'silent' part of the tape before the program appeared (according to the TV) to be very 'noisy'. I discovered that this was caused by my touching the cassette player. By typing in the LOAD instruction, pressing Newline, followed by Play on the tape and then leaving well alone all programs since have loaded perfectly first time.

Whether this is peculiar to my cassette player (which I run off the mains) I do not know, but I suspect it may be a cause of many other ZX81 owners tearing their hair out. R J Bedford Rainham, Kent

Buying Beebon

Time is rushing on towards Jan 1982 & the projected BBC Series on Computers. What, when, where & how will one be able to purchase a suitable machine? Will Acorn be the only manufacturer? Can one put in an order now? Jim D Stewart, Helensburgh, Dumbartonshire.

Early order forms for institutional purchasers can be obtained from: BBC Micro-

computer System, PO Box 7, London W3 6XJ. Individuals will be placed on file & sent a form in October. Manufacturing will be done by Cleartone.

Econet reply

Could I take the opportunity to comment on your mostly accurate and comprehensive review of the Acorn Econet, and correct one or two slip-ups regarding the system's capabilities.

1. The Econet system which you reviewed does support a 'simple yet robust security system for user files'. The qualifier which you mentioned, ensures that one user cannot access another user's files, although there can exist 'public' files which are read only for every user in the system. This is clearly pointed out on page 4 of the document 'Econet Version I — User Manual';

2. The Pascal system which was reviewed was a pre-release version not modified for Econet use. The final release will be mapped to locations C000 upwards, leaving A000 to B000 for the complete Econet software. Incidentally, the captions to the illustrations on page 82 described the Econet board as a Pascal extension and vice-versa;

3. Two smaller points. Combining the printer server and file server would certainly save the cost of a minimum Atom acting as a print server, but at what seems to us considerable loss of performance of the file server. The 16-bit station number is not designed to support 64,000 Atoms on a single network, but to alleviate addressing problems when several systems (Cambridge Ring, Ethernet possibly) are attached to the Econet via a gateway;

4. We accept your reservations about low-level security (ability to POKE, RESET other machines at will) and the new Econet software (ready this month) rectifies the problem.

Finally, the new file server which supports a hierarchical directory structure and is a considerable step forward from the one you reviewed, becomes available this month, and plans are certainly well advanced for random access files and a hard disk system. This will be available in two to three months' time. J Dunn, Acorn Computers Ltd, Cambridge.

Free, free

Mr Slodzik's revelation about USR(2383) giving the amount of free memory is invaluable.

Can he perhaps perform the same miracle for the ZX81?

Paul Taylor, London, W12 9RL

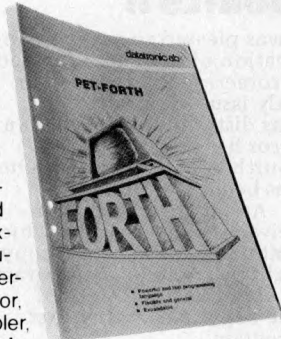
Unique accessories to PET/CBM add more power

Software

PET-FORTH

A unique, extensible programming language that in many cases has cut program development time to a fraction of the normal. FORTH allows you to program **any** type of application, thanks to its extensible nature. FORTH programs are modular, structured, extremely fast, and compact. PET-FORTH is a full, extended, standard FORTH, and includes a virtual memory facility, an interpreter and compiler, a resident editor, as well as a resident macro assembler, all which fits in 8.5K – **simultaneously**.

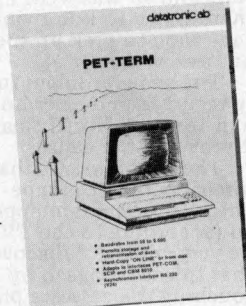
A comprehensive manual of more than 320 pages, which also is an exhaustive tutorial, is included. For production purposes we can supply a special **Target Compiler**, that will produce code suitable for placement in ROM, enabling you to write programs for control of digital machines etc. We use FORTH ourselves for business, data base and process control applications. PET-FORTH includes a life-time guarantee. For 8032 only.



Price: **PET-FORTH, including manual** £ 195
PET-FORTH, only manual £ 20
Target compiler £ 500
PET-FORTH

PET-TERM

A program that turns your PET/CBM 8032 into an intelligent terminal. Supports three different interfaces: the PET-COM, the SCIP or the CBM 8010 acoustic coupler. You may communicate at up to 9600 baud, with selectable framing and parity. PET-TERM will also translate and transmit Word-Pro files. Data may be printed on the printer or saved on disk. PET-TERM includes a life-time guarantee.



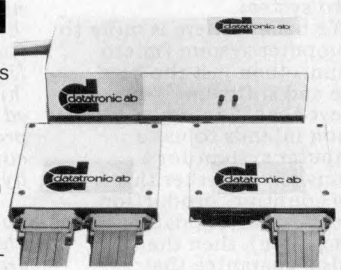
Price: **PET-TERM, including manual** £ 90
PET-TERM, only manual £ 10

Dealers are invited.

Hardware

PET-SWITCH

At a sensational price of £ 75 per unit, PET-SWITCH enables you to connect up to 16 PET/CBM computers to one disk drive and one printer. You can mix all models of PET/CBM in the same system (2001, 3032, 8032 etc). PET-SWITCH is technically superior to most of its competitors – no priority problems for example.



Price: **PET-SWITCH, mother unit** £ 125
PET-SWITCH, daughter unit £ 75

SCIP

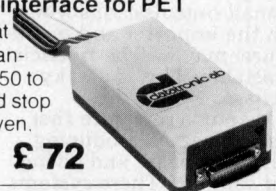
A Serial Communication Interface that supplies both RS-232 and Current Loop. Programmable baudrate. Addressed as an IEEE device. 50 character internal buffer. Selectable ASCII translation.



Price: £ 240

PET-COM – RS-232C interface for PET

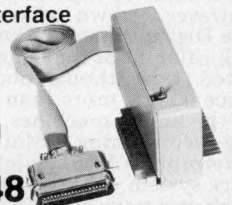
A bidirectional RS-232C interface that connects to PET via the memory expansion port. The baud rates range from 50 to 9600, and the number of data bits and stop bits is selectable. You may also set even, odd, or no parity.



Price: £ 72

PET IEEE to Centronics Interface

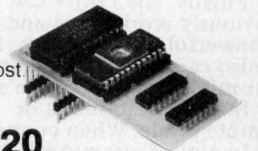
This IEEE => Centronics interface is especially constructed for the PET. It is fully addressable and translates from PET-ASCII to Standard ASCII in two different modes, corresponding to PET's graphic and upper/lower case modes. This is available through a built-in switch.



Price: £ 48

Country specific Character Generator for the 4022 and 3022 printers

By using this board you can have Greek, French, German, or any other special characters in your printer, at a very low cost. It is already used in all Nordic countries, and several other countries have requested it.



Price: £ 20

Datatronic AB is since 1978 sole Swedish distributor of the Commodore computer product line, and is now market leading in microcomputer technology in Scandinavia. Datatronic AB has a long experience in both hardware and software; today Datatronic has used more than 150.000 man-hours in software and hardware development for the PET. All non-Commodore products are produced and tested in-house. The Datatronic-group, which is the fastest growing electronics group in Scandinavia, has a turnover of approximately \$ 30.000.000, and employs over 200 people.

For further information contact Datatronic AB,
Box 42094, S-126 12 Stockholm, Sweden.
Phone 8-744 5920
or your nearest Commodore dealer.



Box 42094 · S-126 12 STOCKHOLM · Sweden
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According to our contact at Sinclair Research, you should get the answer by subtracting the address at STKEND from the address at ERR-SP. Take another 20 or so bytes to allow for the stack and Bob's your uncle — Ed.

Memory plug

I recently purchased an Acorn Atom computer which has proved to be a very satisfactory machine to work with. So much so, that I decided to extend the text memory from the 'on board' 6k. I purchased from Acorn an 8k static RAM card which could be fitted inside the case.

You can imagine my amazement to discover that the off-board memory addressing of the Atom starts at #3C00, whereas the nearest settable starting point for its 8k memory eurocard is #4000. This means that there is a 1k hole in the memory map for this machine. I hope it gets it right for the BBC micro.

For readers interested in increasing the memory size and obtaining contiguous memory, here's how:

The trick is to add another 1k of static RAM (2114Ls) to the Atom printed circuit board. The modification does not damage the circuit in any way. Take two 2114L RAM chips and bend sideways pin 8, the chip select pin. Carefully solder these piggyback style on top of IC 18 and IC 19. Next remove IC6 and bend sideways pin 7, then reinsert the chip. Next remove IC5 and bend sideways pin 1 before reinserting the chip. Finally connect with a piece of insulated wire, pins 8 of the new memory chips to IC 5 pin 1 and IC6 pin 7.

The off-card memory addressing now starts at #4000. The addition of 8k of static RAM will now give you 15k of contiguous text memory.
J C Flower, Cowplain, Hants.

Basic book

We feel that Chris Sadler's review of our book *Computer Programming in Basic* (Teach Yourself Books, Hodder & Stoughton, 1981) was inaccurate and could mislead potential readers.

Firstly, the aim of the book is to introduce *absolute beginners* to the syntax of Basic by means of simplified yet realistic examples of applications. Commenting on specific points:

1. Table 7.5 in the book illustrates how FOR...NEXT statements *work* and is not intended to be an example of programming practice. Your reviewer appears to have missed the sentence on page 60, 'You may use I within the loop, but you should avoid changing I (that is

assigning a new value to I) within the loop as this changes the conditions set up by the FOR...NEXT statements';

2. As the book has not been written for use with one system in particular, there is a general chapter on the types of system command. This chapter is aimed at giving an understanding of why these commands need to be provided. However, the user has to be advised to establish the commands available on his system;

3. The sequence chosen in writing the book is based upon our teaching experience. All programs need to be tested and therefore the subjects raised early (Chapter 5) in the book and illustrated by means of a flowchart (containing branches) before the detailed syntax is covered in Chapter 7;

4. We agree that adding the decimal equivalents to the appendix of ASCII codes would be useful. However, this appendix was included to illustrate how characters can be held in a computer, as part of the discussion on page 5 of the book;

5. We are puzzled by the reference to 'mainframe origins' as all the programs were developed for and have been run on microcomputers (eg, the Commodore PET).
L H Carter and E Huzan, Slough, Berks.

Chris Sadler replies. . . Sorry about the 'mainframe origins'. I was confused by section 6.2 which describes 'logging-in' and 'passwords'. These are not implemented on any PET I have used.

Beeb blast

Poor Mr Jonathan Palmer. In a few short sentences he has succeeded in proving the very point his letter was intended to contest. In his case, Basic has certainly managed to achieve a total confusion between the equals sign used as a relational operator and its use to perform assignment.

In case anyone is still perplexed, let's just remember that when used in its proper mathematical sense '=' means 'is equal to', expressing an empirical fact or theoretical truth. When used for assignment, it has a quite different meaning: 'discard the value, if any, of this variable and assign to it the value of the expression which follows the equals sign.'

The confusion arises at least partly because so many forms of Basic unfortunately regard the keyword LET as optional.

No, Mr Palmer, we don't teach school children to write $2 \times 3 = 6$ because this is not an assignment. We use '=' to express what is, we hope, a universal and eternal equality.

But perhaps it would also be better if we did not teach them to write irrational nonsense like $x = x + 2$ such as found in Fortran and its descendant Basic.
Paul Kriwaczek, Producer, Computer Literacy Project, London

Sharp points

I was interested to read (July issue) your Bench-test of the Sharp PC-3201, having recently acquired one. As your reviewer says, speed of execution has been sacrificed in the interests of convenience for business software. She did not mention some extremely valuable features of the Basic, though, so perhaps I could point these out.

Firstly, the subprograms make it possible to write truly structured Basic programs. In large business programs, it is all too easy to re-use main program variables in subroutines, sometimes with disastrous results. In PC-3201 Basic, one can write for example:

```
CALL GETCUST (X, Y, AS(*))
```

Whatever variables are used in the subprogram, the only main program variables affected will be X, Y and the array AS (*).

Not only subprograms, but subroutines and jump points may be named. Some of my business programs for TRS-80 include lines such as:

```
1800 GOSUB 30200:GOSUB 27800: GOSUB 8700 . . .
```

This gives no clue as to what the subroutines do. With the Sharp, one can write:

```
1800 GOSUB "NEWPAGE":  
GOSUB "PRINTADDR":  
GOTO "MENU"
```

Any line may be prefixed with a string label after the line number.

For inputting data, the Sharp Basic is highly screen-oriented. For example, one can position the cursor anywhere on the VDU and execute ENTER AS, X, whereupon the X characters on the screen following the cursor are assigned to the variable AS. Data entry is also speeded with a keyboard buffer, enabling the operator to work a hundred or so characters ahead.

The CE-332P printer supplied as standard features access to the individual dots, permitting graphics with 1/72in resolution. One Sunday morning as an exercise I wrote a program to print Hebrew. I have received favourable comments on the typography from the Rev Saul Amyas MBE, a leading London rabbi.

In my view, these advantages far outweigh the disadvantage of slow arithmetic where business applications are concerned.

George Sassoon, Warminster, Wilts.

Puzzling program

Can anyone please solve a problem for me?

I noted a puzzle which said 'what number when multiplied by 6 gives the same answer as that number added to 12?' although it would be interesting to write a program for my ZX81, as follows:-

```
10 FOR X=1 TO 3 STEP 0.1  
20  
30  
40  
50 PRINT TAB 10; B  
60  
70
```

This works but if you change line 10 to read:
FOR X=0 TO 3 STEP 0.1
it doesn't! Why?
J A Watson Wilmslow, Cheshire.

I give in. Why? — Ed.

Pascal preferred

Jonathan Palmer's letter in the July 1981 edition of PCW had some good defences for the much-maligned Basic, but he has got it all wrong when he criticises the := of Pascal. Basic's use of = is often misleading. Both it, and :=, should be pronounced 'becomes' rather than 'equals' since that expresses their function (that's why we don't write 2×3 becomes 6). What would his school-children make of the algebraically meaningless $A = (\text{equals}) A + 1$?

We have had := ever since Algol 60 and it really does make life easier for compiler writers. Most modern high level languages (including many Basics) treat = as an operator yielding a truth value. If Mr Palmer cannot see the ambiguity in the statement $A = B = C$ (accepted by Microsoft Basic without question) then he should compare it with the Algol 68 multiple assignment $a := b := c$ (which performs the functions of $b := c; a := b$).

On the subject of Algol 68s, Jon Fairbairn's compiler for Algol 68s is now nearly working. Unfortunately it needs 85k bytes on a Z80! Now all he needs is a Z8000 and a cross-assembler. . .
Nick Brown, Birmingham.





HI-TECH SPEAKEASY CARD

*Neil Cryer tests an add-on which will
give your computer a voice!*

The Hi-Tech Speakeasy Card is an S100 board complete with a loudspeaker mounted on one corner. It can speak 144 'utterances' of words, phrases and prefixes which may be strung together in any order to produce phrases and sentences. Speech is accomplished with a National Semiconductor chip set, including the Digitalker speech processor chip and two 64 kbit ROMs. National Semiconductor has used a sophisticated compression technique to reduce the information held in digitised speech waveforms so that it can be stored in ROM. The board speaks when the user sends it a code to indicate the part of the store to be re-expanded.

Installation

The modest requirements of the Speakeasy Card should make it compatible with most S100 systems. The board looks like a port to the computer and so requires only the lower eight address lines, eight data lines and only five other control signals. The exact port address is user-selectable anywhere between 0 and 255, via a mini block of eight switches. The required S100 signals are: eight lower address lines (AO - A7); eight data lines Do(0) - Do(7); DI(0); PWR; PINT; SINP; SOUT; PDBIN.

The board is very easy to install. Documentation is brief but adequate, so there is virtually no delay between plugging in and obtaining an utterance.

Vocabulary

Table 1 shows the words that can be spoken by the Speakeasy Card together with their codes. Speech occurs when the appropriate code is sent to the Speakeasy port. For example, utterance of 'twenty three volts' can be achieved

by means of the following program. The codes 20, 3 and 142 are used for the words 'twenty', 'three' and 'volt'. 129 supplies the zzz sound to make plurals — in this case the plural of volt — and 63 supplies a short silence to separate words.

```
10 REM Port for Speakeasy is 144
20 READ W
30 OUT 144, W :REM say word
40 IF IN(144) AND ! THEN 30 :REM
   busy
50 GOTO 10 :REM clear for next word
60 DATA 20, 63, 3, 63, 142, 129
```

Line 30 checks whether the board is still busy with the current word. If it is, bit 0 of the same port is set and line 30 loops to itself. Reaching line 40 requires that speech has finished and the next word can be processed. The program finishes when it runs out of data.

The Speakeasy documentation gives an adequate number of such example programs.

Speech quality

In normal speech, words are run together rather than spoken separately. Speakeasy, however, with only a few exceptions, makes isolated utterances, and neither inflection nor pitch can be altered. It therefore tends to sound jerky. Some extra intelligibility and naturalness can be programmed in by altering the duration of the silences between words. Five are available, from 20 milliseconds to 320 milliseconds, and are addressed as normal words.

Speakeasy's speech is completely intelligible, although it cannot be mistaken for live discourse. The accent is definitely American, which may be a disadvantage for the British market.

On the review board a high

frequency noise came through with some of the speech. It was not excessive and probably derived from the decompression and resynthesis. I would have liked to have tried removing it with a sharp cut-off filter but one was not to hand. I did note, however, that the high frequency noise was less noticeable when recorded with a cheap cassette recorder. This confirms that the high frequency filter would help.

Increasing the vocabulary

As soon as the board receives the appropriate code, it starts saying the new word, even if it is still in the middle of the previous one. This allows certain new words to be made by joining parts of existing ones. For example, the first entry in Speakeasy's vocabulary happens to be the three word utterance: 'This is Digitalker'. The first two words 'This is' can be extracted and used with any of the other entries, as can the 'per' from 'percent' and the 'can' from 'cancel', etc. This sort of vocabulary building is somewhat limited as new utterances can only be created from the beginnings of existing ones. Ends of utterances cannot be extracted.

It is very easy to build onto the vocabulary in this way. For example the following simple program illustrates how I could extract 'per' from 'percent' using my computer. (For the same timing with another computer, the for-next loop may need some adjustment.) The code for 'percent' is 119. If, after a suitably judged delay, this is followed by 71 for a silence, then the board just says 'per':

```
10 OUT 144,119 :REM say PERCENT
20 FOR I=1 TO 140: NEXT I
30 OUT 144,71 :REM SILENCE
```

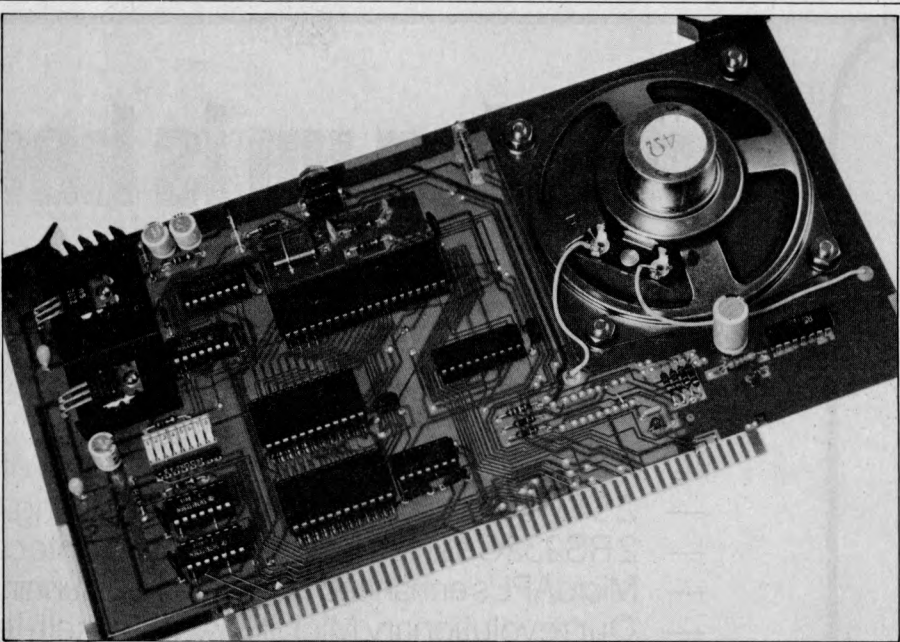

An extracted sound may be fitted into a whole string of words by inserting lines like these at the appropriate place in a program.

Use with interrupts

If a link on the board is connected, an interrupt is given at the end of each utterance. This may be useful if, for example, the board is part of an animated game. The computer could then spend most of its time running the game or other activity. The interrupt could be used to get the next word from a table and send it to the board before containing with the main task. In this way, a game could be given a commentary without it being slowed down significantly.

Summary

The National semiconductor chip-set is a considerable technical achievement. At £185, the Speakeasy Card is a gateway to instant speech from a micro. The speech is clear, intelligible, and American. Customised vocabularies will be supplied, but they are way beyond the pockets of individuals. Rumour has it that Hi-Tech may eventually produce



other off-the-shelf vocabularies. A future composite of perhaps over a thousand words is something which I see as offering enormous possibilities. Speakeasy gives a glimpse into such a future.

word	code	word	code	word	code
THIS IS DIGITALKER	0	Q	48	IS	96
ONE	1	R	49	IT	97
TWO	2	S	50	KILO	98
THREE	3	T	51	LEFT	99
FOUR	4	U	52	LESS	100
FIVE	5	V	53	LESSER	101
SIX	6	W	54	LIMIT	102
SEVEN	7	X	55	LOW	103
EIGHT	8	Y	56	LOWER	104
NINE	9	Z	57	MARK	105
TEN	10	AGAIN	58	METER	106
ELEVEN	11	AMPERE	59	MILE	107
TWELVE	12	AND	60	MILLI	108
THIRTEEN	13	AT	61	MINUS	109
FOURTEEN	14	CANCEL	62	MINUTE	110
FIFTEEN	15	CASE	63	NEAR	111
SIXTEEN	16	CENT	64	NUMBER	112
SEVENTEEN	17	400 HERTZ TONE	65	OF	113
EIGHTEEN	18	80 HERTZ TONE	66	OFF	114
NINETEEN	19	20 MS SILENCE	67	ON	115
TWENTY	20	40 MS SILENCE	68	OUT	116
THIRTY	21	80 MS SILENCE	69	OVER	117
FORTY	22	160 MS SILENCE	70	PARENTHESIS	118
FIFTY	23	320 MS SILENCE	71	PERCENT	119
SIXTY	24	CENTI	72	PLEASE	120
SEVENTY	25	CHECK	73	PLUS	121
EIGHTY	26	COMMA	74	POINT	122
NINETY	27	CONTROL	75	POUND	123
HUNDRED	28	DANGER	76	PULSES	124
THOUSAND	29	DEGREE	77	RATE	125
MILLION	30	DOLLAR	78	RE	126
ZERO	31	DOWN	79	READY	127
A	32	EQUAL	80	RIGHT	128
B	33	ERROR	81	SS (Note 1)	129
C	34	FEET	82	SECOND	130
D	35	FLOW	83	SET	131
E	36	FUEL	84	SPACE	132
F	37	GALLON	85	SPEED	133
G	38	GO	86	STAR	134
H	39	GRAM	87	START	135
I	40	GREAT	88	STOP	136
J	41	GREATER	89	THAN	137
K	42	HAVE	90	THE	138
L	43	HIGH	91	TIME	139
M	44	HIGHER	92	TRY	140
N	45	HOURL	93	UP	141
O	46	IN	94	VOLT	142
P	47	INCHES	95	WEIGHT	143

Note 1: "SS" makes any singular word plural.

Table 1 The Speakeasy vocabulary.

Breaking up is hard to do.

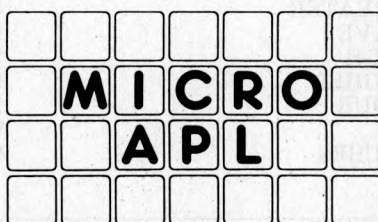
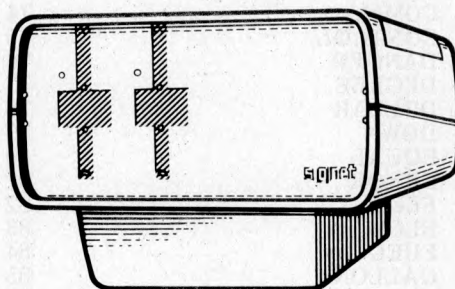
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BANKS' STATEMENT

THE SKULKING MORON

More musings from the Banks biro.

Software, if you'll pardon the pun, is a soft touch for anyone with a yen for making barbed comments about the computer industry. It is, in fact the moron that skulks inside the snazzy boxes of hardware that look so terribly clever.

See, it's easy to have a go at software, especially in the microcomputer business. It rarely is what most people seem to think it might be, or hoped it should have been given luck and God's good grace. Software producers certainly over-step the mark at times, broadly alluding to the wondrous power of the XYZ suite of integrated packages in their advertising. Systems manufacturers often more than broadly allude to the infinite capabilities of their ticky-tacky boxes. . . 'You could run all of GEC's accounts on this wrist-watch-styled gizmo, costing just 27 ppe'.

Yes, the poor bemused punter is often oversold on the joys and wonders of the microcomputer. Sometimes, they are even oversold — dare I say it — deliberately. Well, a sucker is a sucker is a sucker, I suppose.

Many times, however, it would seem that the punters oversell themselves on the whole idea. Often, it is only with great difficulty that they are dragged, kicking and screaming, back to the world of reality, and other boring things like file sizes, field lengths and suchlike.

This self-abusive overselling is probably more prevalent in software than hardware. Since the heady days of the late seventies, when that nasty thing called the microprocessor came to national prominence, there has been a slow but steady awakening in people's perceptions about hardware. They now yawn — through knowledge rather than disinterest — at the old chestnut about 'this box' holding the equivalent power to a computer that used to fill a house.

But the same cannot be said of software. To many people, and certainly to many potential users of microcomputers, the subject of software tends to elicit one of three different and distinct responses. The first is the blank stare, occasionally accompanied by a querulous 'eh?' The second is the dubious enquiry as to whether it is illegal or should be mentioned in polite company. The third response follows the pattern: 'Ah yes, I know about that. I've seen adverts for complete accounts packages for £40.'

Now I know that there are many, many happy and contented users of microcomputers running much good

software and achieving exactly what they set out to do. I also know that there are many individuals writing that software, both for themselves and other people. But at the same time, I also know that there are many, many discontented users who feel they have bought a pig in a poke, and many, many more who haven't bought anything yet but run the risk of one hell of a surprise when they do.

Now, as I have also said (back at the top of the page, remember?) it is easy for someone to sit complacently at a typewriter and have a good whinge and whine about software. Therefore, from this point on I shall try to avoid that. Instead, I will make a suggestion.

It is a suggestion that has been borne out of a story that concerned a user, a particular computer system, and a software supplier. In this context the names don't really matter.

Now the user purchased the computer, because he liked it and then shopped around for some software that would run the applications he had in mind (mainly accounts and job-costing work). This, he now freely admits, was a mistake. He acknowledges that he should have found the applications packages he needed, and then found a machine that would run them. That, unfortunately, is the way that many first time buyers are liable to start.

Now, he found some software that could do the job, at least on paper, but in practice it didn't seem to work out that way. The implementation of the software involved work, correction and bug-hunting, accompanied by much burning of the midnight oil by all concerned. 'It doesn't work,' cried the user, 'and it can't be got to work.'

From that user's point of view that statement was true, and very self-evident, but there was a *but* (isn't there always?).

The *but* in question came from the supplier of the software package, who said, in effect, that he was hardly surprised it didn't work. This was not to say there was anything wrong with the package. In theory it would meet the application nicely. On a bigger machine it would have coped well. 'You see,' said the software man, 'that application, the volume of work to be processed, really needed a minicomputer, though some of the biggest micros could have handled it.'

Therein lies the rub. The user had a good idea — to use a micro computer to run the business accounts — but its implementation was a different matter. The simple (at least in theory) task of gaining a rough quantitative guide to the job, that could be gauged against the known capabilities of a range of machines and software packages, seems to have been missing.

In old style computing (mainframes etc), this exercise is sometimes called systems analysis and is a job for the *crème de la crème* of the brotherhood. Needless to say, that makes it very expensive and takes it beyond the financial pale for the majority of potential micro buyers.

But there is scope for cheaper variations on that theme and, while not so accurate (and even in the mainframe business that is a very relative word), user requirements could be rapidly quantified at the dealer level

and matched to software and hardware.

It occurs to me that there ought to be some way of grading both hardware and software, and also the user's application. Software, in particular, would benefit from this, for it could help both the potential user and dealer. Both would have a common frame of reference around which to discuss an application and its implications.

Hardware would be relatively easy to grade, for it could simply be based on a system's capabilities. For example, on a scale of one to ten, in ascending order of 'power', you could have a Sinclair ZX81 without add-on memory as grade one; grade five might be an Apple/Tandy/Commodore machine running two mini-floppies and a printer; then, at the top (purely for the sake of argument), machines like the Onyx 8000 running over 20 Mbytes of hard disk.

Software would be more difficult to grade, but not impossible. Simple games and educational programs would be grade one, while a fully integrated accounting package with bells and whistles would be grade ten. It would, of course, have to be usable on grade ten hardware. Intermediate gradings of software would be difficult: there would no doubt be a need for further subdivisions into different applications areas, such as engineering, accounting, medical, etc. The gradings should, however, be matched to what the packages can actually do. For example, there could be a very fine general ledger package that does not integrate with any other accounting package. This would have a lower grade than a similar, text integrating package (unless, of course, that integrating package was a bummer).

By the same token, it should be possible for a dealer to have some form of checklist for the user. This could be a series of questions that would allow the dealer to quantify the application, and thus give it a grading that is relative to those for hardware and software, ie, a grade ten application will need a grade ten computer running grade ten software. As a side benefit, such an exercise would help the user gain a better understanding of just what he is trying to achieve, and why. He might end up realising that he doesn't need a computer at all.

I really don't know if such a system of grading is workable, or whether it is economically viable to establish. Ideally, all this would be done by some independent body with no vested interests to protect. The chances of that are remote, to say the least.

But there is scope for enterprising companies, or groups of companies, maybe even the Computer Retailers Association, to have a go. Even if the grading structure was not of the best, it could well be better than nothing at all. I am reminded of the CP/M operating system, which is certainly not the best there is in operating systems, but has succeeded primarily by being there. A poor grading system could succeed by the same token.

A poor grading system that at least gives some quantitative comparison for dealers and users to work on does, however, seem infinitely better than the current state of the oversold wing and a prayer.

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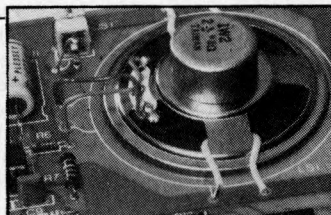
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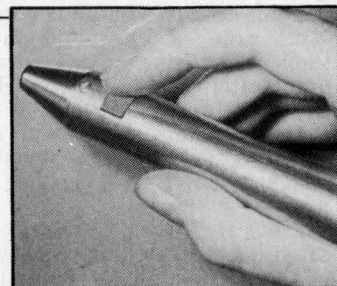
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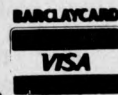
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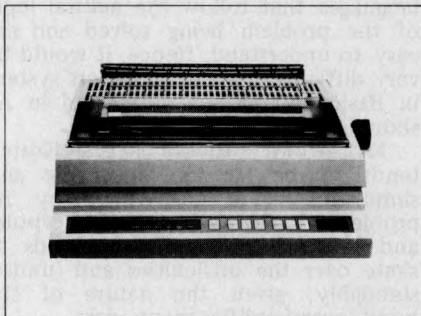
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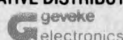
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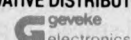
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This month Malcolm Peltu discusses books on communications and AI and examines the latest contributions to the Great Micro Debate.

Chip chat is where it's at

Reader Peter Head (*PCW*, June) has accused me of being illogical, unalert, unconscientious and, even worse, of having Something Important to say. All this because I criticised Basic and called as a witness in my defence a professor at MIT. For this 'Bookfare', I will let lie the sleeping dogs of Basic war. But I unrepentantly offer a strong dose of the Something Important. *PCW* is packed with pages of nitty-gritty personal computing stuff; a dash of perspective adds a byte of spice to the mix.

My Important Little Things this month are computer communications, Artificial Intelligence, and the collapse (or not) of modern industrial civilisation. I will deal with them in this order to show I have not completely forsaken the priorities which computing buffs seem to favour.

Personal computers grew up in a different neck of the woods from traditional mainframe and mini computing. They were developed to their own ragbag of ad hoc standards, without much relation to their bigger computing comrades. Microcomputers were initially designed primarily for single-site operation and have been generally poorly served by communications capabilities. Meanwhile, in the grown-up part of the forest, mainframes and minis developed intertwined information networks. Computer communications has become the normal mode of operation for most information services.

Now personal computers have also become part of these networks. Most microcomputers are being sold for 'serious' business, industrial and scientific applications. In these activities, communications are vital. But the lack of standardisation in equipment and expertise among some microcomputer users has exacerbated the problems of getting an efficient chip chat going in computer communications systems. To a great extent, the major problem is an educational one. A lot of experience has been built up in the traditional DP business which will help microcomputer communications but which many microcomputer users may not be aware of.

The National Computing Centre has made a commendable attempt to bridge this educational gap with *Communicating with Microcomputers* by John Lane. It's a short, sharp primer of the very basics of communication. As Lane says, 'whilst not intended to provide a complete answer to the problem, the publication aims to establish an awareness of current practices and trends in the field of microcomputer communications'. The book has only 66 small pages with well-spaced type. It would be ideal as part of a course on computer communication or as an introductory book for someone with an existing smattering of knowledge.

It starts with some essential background on the historical development

of communicating with mainframes. This illustrates the way various protocol standards developed to help smooth computer chat.

In the 1960s and '70s, computer manufacturers used the computing Tower of Babel to hook users to their product lines. In pre-micro days, it was prohibitively expensive to provide facilities to allow 'alien' computer units to talk to each other. Minicomputers helped by enabling emulators and interface devices to be developed. This meant a minicomputer could be used to provide local processing on-site and then be hooked to a mainframe, when it would emulate the communications protocol for that mainframe.

Microcomputers have extended this process and provide cheaper, more powerful emulators. Lane describes a number of microcomputer communications packages in bare outline: Z80 ASYNC, BS-3780 (an IBM 3780 terminal emulation system), and Data General Nova IBM workstation emulators. He then goes on to discuss how programmable interface chips have largely overcome the problem of incompatible protocols. These chips can be programmed to operate virtually any serial data transmission technique currently in use.

To someone brought up on the clumsy inflexibilities of mainframe communications, this is something of a revolution. To a child of the micro age, the question is, so what? Lane provides enlightenment and clarification from whichever direction the issue is approached.

The specific programmable communications interface chips which he describes are the Intel 8261A, Zilog Z80 serial I/O controller and Intel's 8273 SDLC Protocol Controller. He also discusses software packages, such as the TI DATACOM system, which work in conjunction with a programmable chip to provide 'off-the-peg' products to handle complete communications interface needs. A brief mention is also given to systems like Kingston Computer KC NETKIT, which enables a computer like the PET, which has the IEEE-4888 I/O capability, to communicate with the more standard RS232 devices.

One of the best segments in the book is the description of intelligent local networks. Lane provides a concise description of the Cambridge Ring and a more abbreviated intro to Ethernet. This is followed by summaries of some products on the market: Z-Net, Cluster One, Net/One and CP/Net Communications in industrial microprocessor applications are covered in five pages. That is typical of the book's approach — short summaries rather than fleshed-out material.

As such, it is a valuable book, but do not expect too much from it. It is only a taster for the subject and makes no pretence at being comprehensive in its coverage of the market. But it does indicate why communications is Something Important for personal computer users.

An AI opener

Artificial Intelligence (AI) is also Something Important because it adds a significant dimension to classical computing concepts. AI breaks through the notion of computer as slave and injects some form of human reasoning into computing.

John Krutch has written a snappy little book which provides a practical introduction to some of the notions that AI workers have been studying. His *Experiments in Artificial Intelligence for Small Computers* illustrates AI concepts with some programs written in Basic (Microsoft Level II Basic for the TRS-80, to be precise).

Like the NCC book on micro communications (reviewed above), Krutch's approach is to provide the bare minimum needed to understand the subject. It would also be good as part of a course on AI or as a taster to whether the subject is sufficiently interesting to pursue further. Each chapter has only about ten to 15 pages. It starts with a brief, general statement on the nature of the activity being tackled in the chapter. Then there are a few pages looking at some techniques in more detail. The rest (and bulk) of the chapter is taken up with a detailed look at a Basic program that illustrates the previous discussion. Topics covered include game-playing, problem solving, programs that reason and natural language processing. The programs are generally intrinsically interesting and readers will gain familiarity, at a superficial level, with some of the main AI buzzwords and concepts.

I have three main criticisms. Firstly, Krutch ignores one of the major AI developments: expert systems. These distil expert knowledge into programs which follow human rationale. Expert systems have been developed, for example, to assist in medical diagnosis. Expert systems are written in special languages that follow the natural logic of the problem being solved and are easy to understand. Hence, it would be very difficult to write an expert system in Basic, but anyone interested in AI should delve into expert systems.

My second criticism is that Krutch tends to be far too optimistic and simplistic. There are still many AI problems to be tackled at conceptual and practical levels. Krutch tends to skate over the difficulties and (understandably, given the nature of the book) oversimplifies many ideas.

Thirdly, I wish he had left out two chapters on poetry and prose writing by computer. It is a travesty to suggest that the production of verse or stories by selecting words at random according to a set pattern can be related to the artistic creativity of a human poet or author. One of the main dangers of AI is that it can lead to a devaluation of human expertise, feeling and ingenuity. The essence of any art form is the human experience that goes into it, however subconscious or apparently random the motivation may be. Krutch

exhibits the 'logical' literalness of his own approach when he says that computer poetry can produce lines like 'Breeze of the shape', which, he says, is clearly meaningless. But, in the appropriate context, it is valid poetic image. In poetry, sounds can have colour, sunshine can sing, and breezes can... have shape? — if the poet so wishes.

Krutch quotes the criticisms of Joe Weizenbaum, who highlighted the danger of taking AI too literally. Weizenbaum wrote a program called Doctor which simulated a psychiatrist/patient conversation. He was appalled when it was suggested that an online computer-based psychiatric service could be set up with computer shrinks at the other end of the line. Weizenbaum insisted that the essence of psychiatric treatment is the human understanding of the psychiatrist, which could never be simulated by a computer. But then Weizenbaum is yet another MIT Professor.

And he probably was misled by thinking he had Something Important to say.

Is radicalism the only hope?

Now to what I believe is the most important part of this 'Bookfare'.

At last, a radical approach to coping with the problems of unemployment and technological change is beginning to emerge. During the last month, I have read five books which present a serious argument for a shift of emphasis and a creation of a new vision of the likely nature of future society. The least radical is the Marxist *Science Technology and the Labour Press*, edited by Les Levidow and Bob Young. The most radical comes from ex-Labour MPs Ivor Clemitson and George Rodgers in their *A Life to Live* and the Ecological Party's *Working for a Future*. In between there are two significant contributions from the Council for Science and Society (CSS) and Alan Burns' *The Microchip: Appropriate or Inappropriate Technology?*

Ever since the Great Micro Debate began in 1978, arguments have been polarised between two camps. The

doom and gloomers predicted that micros would lead to mass unemployment and a deterioration of the working environment for many people, leading probably to the collapse of modern industrial civilisation, revolution, and other cataclysms. The boom and zoom optimists said the micro was our last hope. We cannot survive without it. It will improve competitiveness, productivity, wealth, the working environment, the life of disabled people, etc, etc. Micros, they said, would create many more jobs than would be lost. Initially, both were gut reactions, based on very little evaluation of what was actually happening. Led by governments, both Labour and Tory, the initiative has subsequently largely been seized by the boomers.

It is undeniable that British industry cannot opt out of the technical race. The Department of Industry has conducted a propaganda campaign, backed by uncritical TV programmes like the BBC's 'Managing the Micro', to promote the wholesale use of Information Technology. In itself, this campaign is desirable, but it has appeared in an uncritical, imbalanced context. The evidence has been growing that Information Technology will exacerbate an already dramatic growth in unemployment throughout the world. It is also becoming clear that the electronic office could bring with it many problems of alienation and a deterioration of skills which has beset manufacturing automation in the past.

While hardware costs have fallen, technologists are also aware that there are still major risks and costs created by software and systems complexities. Yet all these 'negative' aspects of the technology seldom get a full-blooded airing to counterbalance the pro-technology propaganda.

The radical opposition forces have begun to marshal their arguments, however. Some of the recent books have illustrated that it is possible to highlight negative consequences of technology and still be an optimist. The optimism arises from an attitude which emphasises human rather than technological values. Clemitson and Rodgers, for example, argue cogently for a 'life ethic' to replace a 'work ethic'. Their argument is more hard-edged than the Clive Jenkins and Barrie Sherman notion of the 'Leisure Society', but it is a recognition that 'the goal of full employment, interpreted as it has been to now, is becoming more difficult to achieve'.

The Ecology Party argues that the task of the current generation is to 'reassert the authority of morality over technology'. And the CSS Working Party on New Technology, with a diverse representation from engineering, management, shop floor experiences, economics, sociology, philosophy and social history, succinctly summarises the radical 'humanist' position: 'Considerations of ease, decency and self respect should not be over-ridden by appeals to 'expedient arguments about the supposed "costs" of human policies. The options are usually much more open than the immediate technological imperative seems to demand — and



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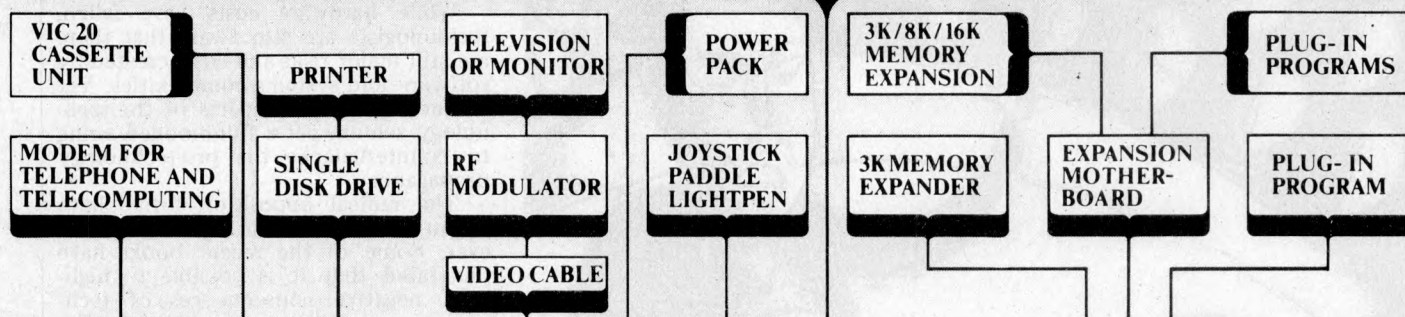
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some of them lead, in the slightly longer run, to much more "efficient" and profitable methods than we could at first have imagined.

"The new technology can just as well be used to create satisfying jobs and enhance natural skills as to destroy and debase jobs. This is obviously a strenuous programme, but fundamentally heartening in its sober optimism."

Most of the books make the question of who controls technology one of the key issues. "Since it is quite clear that in today's economy the introduction of labour-saving machinery strengthens the hand of a very small group of managers and technicians representing the interests of big business, without some acceptance of the need to control the development of technology, one is merely confirming the maintenance of the status quo, and thereby endorsing the inhumanity, the inequality and the fundamentally exploitative politics on which the status quo rests," says the Ecology Party, for example.

Of course, many people will violently disagree with this description of the status quo. But the real point is that technology is a malleable tool. Those who control the way it is shaped determine its effect.

Although each of the books starts and ends from a different perspective or political intent, there is a remarkable unanimity of evidence on some crucial factors:

- Unemployment is rising throughout the world;
- New technologies (Information Technology and biotechnology in particular) will enable wealth to be produced and productivity to increase without increasing employment;
- Opportunities for substantial economic growth in the next ten years are limited, if there is any growth at all;
- Economic pressures are directed towards using more technology and fewer people;
- Full employment is unlikely in the foreseeable future;
- By historical precedence, new technology is likely to move towards job elimination, deskilling, increased fragmentation of work and alienation among the workforce, unless there is greater and more effective industrial democracy;
- Microchip production has been based on the exploitation of mainly female workers in South East Asia;
- Information Technology could bring the worst human effects of automation to office and other white collar work, unless human values are given as much or more priority than business or technological pressures.
- Politicians should gear their policies to these probable realities rather than day dreaming about full employment and rapid economic growth.

The evidence presented is detailed, well argued and generally consistent. It was not long ago that the doom and gloomers were forecasting two million plus unemployed, to the derision of many politicians and economists. Now that is a reality. These books shift the emphasis away from pure argument about the unemployment issue to

questions about the nature of the work that will survive and the methods that could be used to create a stable and humane society in the future.

I believe the two most important books are *A Life to Live* and the CSS report. Clemitson and Rodgers address themselves primarily to the Labour Party and try to work within the existing major power struggle to point the way ahead to a genuinely radical approach. They criticise the wishful thinking of the Labour Left as much as Toryism and pink-to-pale-blue stations in between. The current political orthodoxy, they say, is based on the belief that a full employment society is feasible. By making explicit this is unlikely, Clemitson and Rodgers suggest ways in which the life ethic could provide a more fulfilling, rounded society.

In a foreword, Labour Shadow Cabinet member Neil Kinnock endorses their "inspiring and relevant" alternative. He approvingly quotes Oscar Wilde, who said, "Unless there are slaves to do the ugly, horrible, uninteresting work, culture and contemplation become almost impossible. Human slavery is wrong, insecure and demoralising. On mechanical slavery, on the slavery of machine, the future of the world depends."

Clemitson and Rodgers relate their ideas to current realities. They even say things Margaret Thatcher would love: "There is little point in defending or tolerating waste in the public sector. . . and, 'industry needs more investment, needs to be more efficient, needs to leap forward technologically. . . ' But, unlike most politicians, they balance this with a realistic appraisal of other social, economic and human consequences. Their book should be compulsory reading for all MPs and anyone interested in the future survival of a society based on values other than the profit motive or the dogma of party rule before people rule.

The CSS study is a compromise, reflecting the views of a wide variety of people. But its general drift matches Clemitson and Rodgers' main analysis and identification of problems. It is particularly good in placing new technology in the context of past developments in changing work practices, job satisfaction, work skills, etc. It also refreshingly identifies what it does not know and points to those issues which are still open to a great deal of doubt, such as the timing of the technological impact and the reliability economic forecasting. Once again, I highly recommend this book. It gains and loses by being less committed to one political view. It gains in objectivity and is therefore all the more graphic in the picture it draws of the possibility that technology could cause a great deterioration the quality of life. But it loses by being forced to leave too many untidy loose ends.

Alan Burns' *The Microchip* consists primarily of lucid but conventional descriptions of the nature and applications of computers, micros, etc. It differs from other books of this ilk by concentrating on socially useful applicat-

ions, such as environmental monitors, and in trying to relate Information Technology to the notion of socially-oriented technologies, sometimes called appropriate or convivial technologies.

By ignoring the employment impact, he concludes that the chip is convivial. "The microchip can be misused but 'Misuse' it would be, for structurally the microchip is an appropriate technology," he says. This, however, really begs the questions of how it is likely to be used, how its misuse can be avoided and the crucial significance of the employment impact.

I generally find Burns' social comments woolly and somehow almost an afterthought to what is otherwise a very good, readable, comprehensive overview of technology. (By the way, he includes a good description of expert systems — see my AI review above.) As such an overview, it is an excellent, soft-edged introduction. But I wish it had more on what should be appropriate and less on the technology.

Levidow and Young's book is for the converted. It is subtitled 'Marxist Studies Volume 1.' The first Chapter is a justification of Marx, trying to prove Marx did or did not mean something about technological determinism. It is a pity that the book is encased in such orthodoxy because it has some new and interesting things to say. For example, it incorporates a chapter on biotechnology, which helps to get away from the micro obsession. And there is an interesting perspective on the Grunwick dispute, which suggests that it was an example of what happens when technology causes bad working conditions. But it needs perseverance to delve through the Marxist jargon.

Mr Head, this may all be a long, illogical way from worrying about how many angels are on the side of Basic. But we are all part of a technological movement which, like it or not, is Something Important.

This month's Bookfare featured:

Communicating with Microcomputers by J E Lane (National Computing Centre 'Computing in the 80s' series, £4.00)

Experiments in Artificial Intelligence for Small Computers by John Krutch (Howard W Sams, distributed by Prentice Hall, £4.00)

A Life To Live: Beyond Full Employment by Ivor Clemitson and George Rodgers (Junction Books, 33 Ivor Place London NW1, £3.95 paperback, £9.95 hard)

New Technology: Society, Employment and Skill (Council for Science and Society, 3/4 St Andrews Hill, London EC4, £2.00 paperback £7.00 hard) *Working for a Future* (Ecology Party, 36/38 Clapham Road, London SW9, £1)

The Microchip: Appropriate or Inappropriate Technology? by Alan Burns (Ellis Horwood, distributed by John Wiley, £5.90 paperback, £12.00 cloth) *Science Technology and the Labour Process* edited by Les Levidow and Bob Young (CSE Books, 44 Mount Pleasant, London WC1, £4.95 paperback, £12.00 hard).

TANTEL



*Here's a low-cost Prestel adaptor which will soon be of special interest to microcomputer owners.
John and Peter Douglas conducted the review.*

Before relating our experiences in the use of the Tanel adaptor for Prestel, perhaps a few words about Prestel itself would not be inappropriate.

Prestel is the name of the information service which is provided by British Telecom. It consists of a database of over 170,000 pages. A page consists of a screen-full of information, which is displayed on a viewdata domestic television set. The information comes into your home using your telephone line, but a type 96a jack socket must be fitted by British Telecom, beside the television set, before it can be used to access Prestel.

With the cost of Prestel television sets at about £600, it is not surprising that there is a great deal of consumer resistance to their purchase, especially as many homes already have a colour television. If that set could be adapted to receive Prestel, at about one third of the cost of a new viewdata set, then some of that resistance may subside. That is the hope of a number of manufacturers who have recently introduced Prestel adaptors to the market.

The Tanel adaptor is manufactured in Britain by Tanel Products International Limited, a part of the Tangerine Computer organisation. It costs £170 excluding VAT.

The unit under review was purchased directly from Tanel, although it is now widely available through its authorised dealers.

On unpacking the unit (measuring 237 mm (w) by 160 mm (d) by 55 mm (h) at its rear, with the top sloping to give a mere 30 mm height at its front), the first impression was its weightiness for its size. A large, good quality mains transformer inside the unit and a heavy gauge metal chassis are the reasons for the weight. The electronics are fitted into a black hammer-finish metal case fitted with a white tough plastic top. In the middle of this top is a rectangular sheet of high gloss black plastic. On this sheet, printed in silver, are 16 squares. Ten of these squares have numbers from 0 to 9 printed on them in yellow. The other six squares have a star, a number sign, 'DIS', 'REV', 'BCS', and 'TAPE' printed in yellow. These squares make up the control keypad for the unit. Also printed on the left side of the plastic top are some keying instructions.

There are two leads coming out from the rear of the unit. The first is a three-core mains lead and the second a slim lead terminating in a telephone jack

plug. A co-ax socket and a DIN socket complete the rear panel. A thin lead with a co-ax plug on each end was supplied. All leads are 2m long. A small instruction manual completed the package.

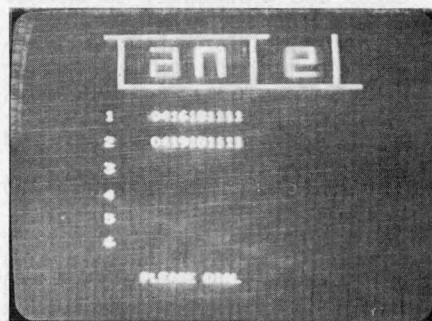
All Prestel sets and adaptors must be registered with the local Prestel office. Before our Tanel could be registered, the type 96a jack socket had to be fitted.

This done, the time had come to enter the vast world of Prestel. The co-ax lead was connected between the socket on the rear of the unit and the aerial socket on a Sanyo 14in colour television set. There is no mains off/on switch on the Tanel and so the mains plug was inserted. Since there is no mains indicator lamp on the unit, there is no way of knowing if the unit is receiving power. On tuning the television set to channel 36, up came the Tanel logo off-line page with the word TANTEL, below which was a column of numbers from 1 to 6, followed by the invitation to PLEASE DIAL.

After fitting the jack plug into its socket, we rang our local Prestel office to register the Tanel unit. Of course, any unit which is to be fitted to a British Telecom telephone line must be BT approved. The Tanel carries this approval and is known to all the local Prestel offices. A charming young lady on the other end of the telephone took details of name, address, phone number and our Tanel serial number. She then asked if the unit and our television set

were connected and switched on. This confirmed, instructions appeared on the screen to press certain keys on the Tanel. This is a test to make sure that the unit is functioning correctly and probably to make sure that the owner knows how to press the keys. Our own space was also being created on the Prestel billing computer (we could have done without that).

The last part of the registration procedure was the insertion of our two local Prestel computer telephone numbers into the Tanel. These numbers and an identity code are held in a battery-operated circuit, which is not affected when the power is disconnected. The Tanel, however, should be connected to the mains for at least one hour per week so that the number information is held. Instructions were displayed so that we could program the numbers into the Tanel. The two telephone numbers then appeared on the screen, opposite the '1' and '2' on the Tanel logo page. Prestel, here we come!



The Tantal Adaptor will automatically dial the Prestel computer when you key in the number opposite which the computer telephone number appears on the Tantal logo page. In our case this is a choice between 1 and 2. Key 1 was pressed, followed by the number sign key. The PLEASE DIAL changed to DIALING and the sounds of this routine were heard through the television loudspeaker.

WELCOME TO PRESTEL came up on the screen, along with details of our name and address and when we had last used that Prestel computer. A flashing cursor sat on the bottom left of the screen.

Prestel had already sent us a couple of Prestel directories. These list subjects such as Aberdeen, Abingdon, Abortion and Abroad, all the way through to Zimbabwe and Zinc. Each entry has its Prestel number beside it. There is a set routine to call up a page. The star sign is pressed. Then the Prestel page number is keyed, for example '209123' for an Aberdeen local weather report. As each key is pressed, its number is displayed at the flashing cursor.

We have found that it is very important to read this display before pressing the final number sign key, as it is very easy on the Tantal to miskey a number and thus have the wrong page of information displayed. It could cost you anything up to 50p for a screen-full of unwanted information! There were two causes of miskeying on our unit, the first of which was easily corrected. Because one of the unit's rubber feet was misaligned, each time a key was pressed, the unit bounced up and down. A wafer of rubber stuck to the offending foot cured this, but the second cause is more serious.

As described above, the keys are printed onto a flexible flat plastic surface. By pressing a printed key, a sensor under the surface is activated. Since the printed keys are situated rather close to each other, your finger, particularly if rather large, can easily press two keys at once. This situation could be improved greatly by raising the key printed portions on the top surface.

On contacting the manufacturer about the keypad design, we were told that the main reason for its present style was economic (the Tantal is the least expensive adaptor on the market at present) but there was another. Since it was hoped that many Tantal units

would find their way into domestic surroundings, the design made sure that the keypad could not be damaged by spilt coffee, biscuit crumbs or other domestic hazards.

Having carefully keyed in the correct page number and pressed the number sign key, the information was speedily displayed. For someone who is used to working with the Ceefax, Oracle or Orbit teletext systems, which can leave you waiting for up to half a minute before the information is displayed, the speed of Prestel retrieval is very impressive.

The readability of the displayed information was good, although where certain colours bordered others, the edges were rather fuzzy. When the 'BSC' key is pressed, the top half of the page fills the screen. Pressing it again fills the screen with the bottom half of the page. This facility makes it easier to read text if you are placed at a distance from the screen. A third press of the key returns the full page to the screen.

While the Tantal is connected to Prestel, there is a connection and a computer access charge adding up. A page of information can contain facts and figures that cannot be taken in at one reading. This is where the 'TAPE' key comes in. A cassette recorder can be connected to the Tantal using a lead with a five-pin DIN plug at one end. This plug is inserted into the DIN socket provided on the unit's rear panel. The other end of the lead should terminate in a suitable plug for the input/output socket on your cassette recorder.

We set up our cassette machine to record and keyed in 'TAPE'. The word TAPE was displayed on the bottom right of the screen, followed by SAVED when the recording was complete. Recording one page takes about five seconds. Then we disconnected the Tantal from Prestel by pressing the 'DIS' key. A LINE DISCONNECTED caption appeared at the foot of the page. Pressing the number sign key brought the Tantal logo page back to the screen.

In the users' manual it states that some experimentation with the cassette recording and playback levels may be necessary for good results. When the cassette was replayed through the Tantal, we were pleased to see the screen fill with the page of information which we had just saved. The only trouble was that as soon as the cassette

recorder was stopped, white squares started to fill the screen, obliterating the information. This was nothing to do with the record or playback levels on the recorder but was due to noise being transmitted on the connecting cable. The manufacturer has now included a modification to cure this problem and will carry out the modification free of charge to any customer who has a unit which exhibits this fault and which is returned. We overcame the problem by using a rather old portable reel-to-reel recorder.

Earlier we mentioned the cost which is mounting up while you are on-line to Prestel. These costs can be cut greatly by calling up each page wanted and recording each onto tape. This system lets you disconnect quickly and view the pages from tape at your leisure. It must be remembered, though, that when you are playing back pages, you are not connected to Prestel and therefore cannot use response pages (pages which are used for games or by direct selling companies).

Many hours have been passed using the Tantal with Prestel and the unit is dependable, except for the tendency to miskey, leading you to unwanted pages. Perhaps that is a Prestel routing problem and nothing to do with Tantal, but that's another story.) Some of the pages invite you to send a message and this is where the Tantal would benefit from an alphanumeric keyboard.

In fact, a model with this facility is soon to become available. A Centronics printer output will also be provided, giving hard copy for Prestel pages. Even more exciting is another Tantal Adaptor which can be interfaced for direct use with home computers such as the PET and Apple. It will contain a colour card which, when used with a colour television set, will give colour capability to your computer. The best news is that it is soon to be available and will cost no more than the present Tantal Adaptor.

To summarise: the Tantal adaptor is well built and looks good even in domestic surroundings; it is simple to connect up; a mains switch or indicator should have been fitted; the keys on the keypad should be raised to avoid miskeying; the six-page Instruction Manual is well printed and easy to understand.

At £170 plus VAT, the Tantal is good value for money.

WRITING FOR PCW

PCW welcomes approaches from would-be writers, even those who may never have appeared in print before. In this game it is often those with practical experience who have important things to say so we don't mind too much if their prose is less than perfect. Providing that submissions have a sensible structure and follow a logical sequence, we can take care of the polishing. Here are some tips:

If the article is already written, simply send it in, making sure that your name, address and 'phone number

appear on both the article and the covering letter. If you have submitted the same work to other magazines you should tell us — it would be embarrassing (to say the least) if the same article appeared in more than one.

If you have an idea for an article or a series, write us a letter outlining your ideas. A one or two page synopsis giving the proposed structure, sequence and content will give us a sound basis for discussion. Please give us a daytime 'phone number if possible.

If you have nothing specific in mind but feel qualified to conduct case studies, Benchtests or whatever then drop us a line saying what you'd like to do and why you think you're qualified

to do it. We're not particularly looking for strings of academic qualifications — experience carries just as much weight.

Dick Pountain is always on the lookout for interesting calculator features and we wouldn't mind seeing one or two readers getting on their soapboxes but remember: even articles such as this need a structure.

Reading PCW will give you a good idea of the style we prefer. You may notice that we try to avoid pomposity at one extreme and flippancy at the other (except in 'Chip Chat', that is).

Finally, have a look through back issue indexes and try not to re-invent any wheels. Oh, we almost forgot — PCW does pay for all published work.

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DEALERS NATIONWIDE

Age before beauty

My friend was only half-jesting the other day when he asserted that my computer still had valves in it! I was being teased and knew it but the real point about the jest was that my computer is four and a half years old — and what a commentary on the rate of development it is, that something so young should be considered to be old-fashioned!

To put it into a timescale, my SWTP 6800 computer was bought long before Sinclair's ZX80 appeared and even before the PET or Tandy were sold here, so you could say that my machine and I are old hands. When I first bought the machine, the largest memory capacity on one board was a mere 4k; now for about twice the price I can buy a board of the same size that will hold 32k of memory — and 64k boards are promised. Not bad for four years of development!

It so happened that about the time that my friend was making his joke, I was hard at work on an article about the future of computers — especially in education — and so I have been forced to think about the past, the present and the future more or less together. One of the things that struck me was that, despite appearances, periods of extremely rapid development have occurred in the past. A period of just six years covered the Wright brothers' first powered flight at Kittyhawk and Bleriot's crossing of the Channel, while a mere four years separated the Tiger Moth trainer aircraft of 1939 from the V2 rocket-powered bomb of 1943, so the rapid development of microcomputers over the last four years is not unique in that respect.

It's interesting and a little galling, however, to be told that something you bought four years ago is now old-fashioned, especially when that something cost you a lot of money! I'm also struck by the thought that if you buy a marvellous machine and then someone brings out an even better one, you have still got a marvellous machine; the fact that there are others even better does not detract from the capabilities of the one you have bought. If tomorrow someone builds a structure twice as high as the Empire State Building, that doesn't make the ESB any smaller!

People worry a little over whether to buy a computer now, or wait for the even better machine to come. There is only one answer — buy now. If you put off buying on the grounds that tomorrow's computers will make today's look stupid, then you will put off buying for a very long time to come and in the meantime deny yourself the pleasure of owning and using one of these most fascinating devices.

I don't mind at all when people tease me about my 'old' computer. Besides — that battered and much-travelled case conceals something that I can afford to smile about — some of the most up-to-date circuitry and sophisticated facili-

ties available on any minicomputer. So there!

Microtrain

It was in this frame of mind that I went along to have a look at the DoI's Microtrain and I have to confess to a feeling of disappointment. For a start, while the train is seven carriages long, only two of them are given over to exhibits — and you can't get a lot into that space when you have to allow for the movement of people past the exhibition. More importantly, when I was there I could find no one of whom to ask questions or request demonstrations. Since some three-quarters of the exhibits were not working at the time, or had locked out the casual user, this was frustrating not only to me but also to the 20 or 30 youngsters there at the same time.

In fairness to the DoI, it must be said that school pupils are not their target but business people are, so my general comment for young readers is go and see it by all means, but don't travel far out of your way to do so unless you're near school-leaving age and are going into control technology, or something.

Programs received

Soccer (Compukit) by Chris Thompson of Orpington.
Playboy Bunny by J Mason (15) of Cleveland.
Six — no less — programs for ZX81 by Daniel Haywood (13) of Ormskirk.
Helicopter for ZX81 by Kevin Kirkland (16) of Newport.
Catch Me for ZX81 by Stuart Haywood (14) of Wellington, Somerset.
Pattern Drawer (TRS80) by A N Bell (16) of Flackwell Heath, Bucks.
Attack (ZX81) by Jonathon Hale of Leeds.
Rotate (Atom) by Steven Ross (15) of Eastham, Merseyside.
League Table (ZX80) by Christopher Teague (15) of Bourne.
U-Boat Alley (ZX81) by Andrew Smith (15) of Leigh-on-Sea.
Times Tables and Duck Shoot (ZX81) by Andrew Hooley (13) of Bury.

Binary Loader (PET) by Neil Stoker (17) of Gateshead.

Wumpus, Two-Man Breakout and Super-Meteor (TRS80) by Andrew Bennett (16) of Ladbroke, Warwicks.

Once again, my thanks to all of you. You're certainly keeping me on my toes. Of course (said he sourly), I know what's going to happen; before long somebody is going to write in and complain that all we publish is programs for the ZX80 and ZX81 — just as they used to complain that all we did was publish programs for the PET. It's not true, of course, but that doesn't stop folks saying it. The list above is the perfect rebuttal of the argument: we naturally receive most programs for whatever machine is selling best at the moment and by the Law of Averages (or something) it's those programs that will tend to be published more often. So — if you want to see a program for your favourite machine, send one in!

Mugtraps

New Mugtraps have been a bit thin on the ground this month, but Neil Stoker sent in an improved version of his mugtrap for the PET that we published a little while ago. K R Jones of Lytham St. Anne's also wrote in about Neil's mugtrap, offering an even better version. I've not tried it, but here it is — 1327 (eg) INPUT "XS";XS becomes
1327 INPUT "XS left left left * right right right";XS 1328 IF XS="*" THEN "up up": GOTO 1327

As I understand it, a star is given as a prompt and if the mug presses C/R without data — which normally crashes the system — the text and star prompt are repeated. It has the great virtue of being simple and extremely economical. Thank you, Kevin! You get this month's book-token and the gratitude of all PET users.

Thought for the month

Whatever did we do before Space Invaders appeared?

PET Helicopter by Kevin Kirkland

The object is to land a helicopter on the very left end of a moving flight deck. You control the helicopter with the cursor control keys, which allow you to

move it left, right or down — but not up! If you succeed, you're given your score in minutes.

•	5 LET S=0	•
•	10 LET R=14	•
•	20 LET H=14	•
•	30 LET HD=0	•
•	35 CLS	•
•	36 LET S=S+1	•
•	40 PRINT AT HD,H: " 	•
•	50 PRINT AT 11,R: " 	•
•	60 LET Z=INT (RND*2)+1	•

GOTO page 167

TRS-80 COLOR COMPUTER



Steve Withers conducts the Benchtest

The TRS-80 Color Computer represents a major departure from Radio Shack traditions. First, although the 'TRS-80' trademark is still used, the processor is the Motorola 6809 ('another leap forward in 8-bit processing power', *PCW* Vol 1, No 11, page 36). Second, it can be used with plug-in ROM packs. Third, it offers high-resolution (256 by 192) colour graphics.

The cheapest Color Computer comes with 4k of memory which can be increased to 16k. The only significant option is 'Extended Color Basic' which provides additional functions, including access to the high-resolution graphics, but requires the extra RAM.

Before I go into any detail, I should stress that as yet there is no UK version of the Color Computer. A model with a PAL TV interface is under development, but the sample tested was supplied with an American receiver. On top of this, various seals had been broken, suggesting cavalier treatment in the past.

Hardware

Housed in a plastic case in the now-familiar silver and black colour scheme, the Color Computer measures 15in wide by 14in deep, and is 3¾in high.

The single printed circuit board is half the size of the case, and about one

third of it is taken up by the power supply. The majority of the digital components are housed in a metal can, presumably to eliminate RF interference. The use of advanced components results in a surprisingly small chip count. Apart from the 6809 processor, there is a 6883 synchronous address multiplexer which generates the necessary timing signals and refreshes the dynamic memory. Two chips dealing with the video output, a pair of peripheral interface adaptors, the ROMs containing the firmware, and that's about it. Outside the can there are some more components, but the overall impression is of a remarkably small number of ICs to achieve so much.

Like the Sorcerer, the Color Computer makes use of ROM packs which plug into a socket on the right-hand side of the case. These 'Program Paks' get control of the system when they are present at power-on; otherwise, the resident Basic interpreter is used.

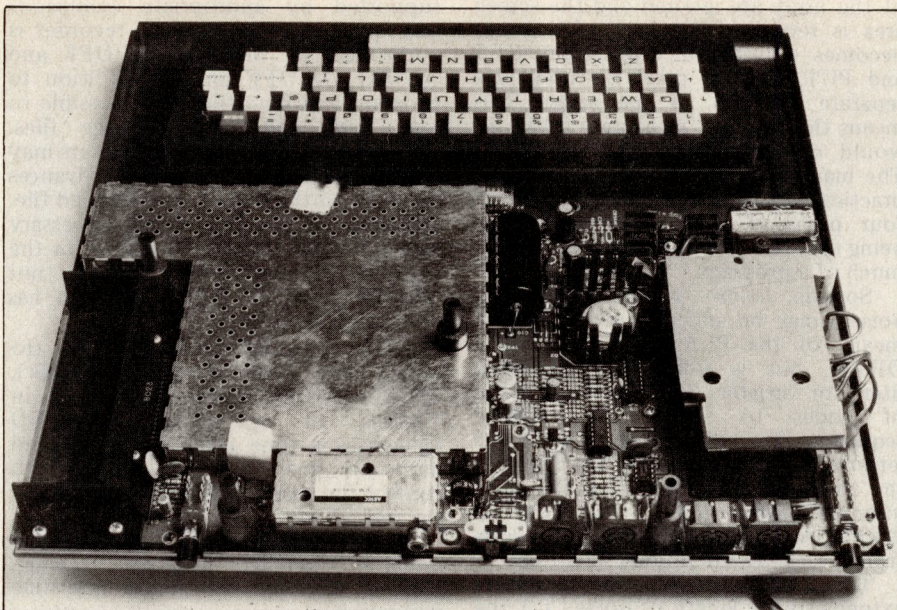
The keyboard is unfortunately of the calculator type — although the spacing approximates that of a typewriter, the keys are 'clicky' and require more pressure than normal, and although the keytops are curved, they are not dished, adding to the lack of 'feel'. While it is better than the original PET keyboard, it is not really suitable for entering large

amounts of text, though if you accept the premise that this computer is intended for domestic use, then the keyboard is adequate.

The video display is controlled by the remarkably powerful MC6847 IC. In text mode it provides 16 lines of 32 characters, which isn't enough for word processing, and is no more than adequate when programming, but it is very clear and completely legible at normal viewing distances. The display is normally black on a green background but can be changed to red on yellow within a program. Both combinations can be reversed, although the expected green on black appeared as green on dark green. Whenever a Basic program calls for input, or the system returns to the command mode, the display returns to normal.

As well as the upper case character set (lower case is shown by inverse video) the internal character generator produces 128 graphics characters. These characters give a resolution of 64 by 32 (ie, two by two in each character position) but each may be displayed in any one of eight colours — green, yellow, blue, red, buff, cyan, magenta, and orange. These characters all have a black background, so nothing really fancy is possible.

This limitation is insignificant,



because a variety of graphics modes are available. The maximum resolution available is 256 by 192 and up to four colours are available. Unfortunately, there is a trade-off between memory consumption, resolution and colour choice, as Table 1 shows.

Grid Size	Colour Choice	Pages Used
256 by 192	2	4
128 by 192	4	4
128 by 192	2	2
128 by 96	4	2
128 by 96	2	1

Table 1

Each page of graphics memory consumes 1.5k of RAM and it is possible to reserve sufficient memory for eight pages. Simple arithmetic shows that if all eight pages are used there is not much memory left for a Basic program and its variables — 2.5k, in fact, since memory is also needed for the text display and for system use. More than one screenful may be used, providing the page limit is not exceeded. This has exciting implications for simple animation, since the switch from one screenful to another is instantaneous.

Graphics coordinates are specified in terms of the finest grid, regardless of the resolution selected, so the bottom right-hand corner of the display is always (256,192). My initial reaction was that this was rather odd, but it has the advantage that if you decide to use a higher resolution than originally planned, there is no need to change all the plotting statements.

All eight colours listed above are available in the graphics modes, but not all at once. In two-colour modes the choice is between black/green and black/buff. The two four-colour sets are

green/yellow/blue/red and buff/cyan/magenta/orange. At first I was disappointed by this restriction but the games programs show what can be done given sufficient imagination.

A feature of this computer is that audio information is added to the TV signal. Sounds may be generated by the computer, or they may come from the optional cassette recorder also used for program and data storage. This would allow spoken instructions to be recorded after the program, for instance. Speech synthesis of a sort is possible by careful use of the hardware but the skiing game's generation of the starter's voice is unintelligible unless you have read the manual and know what the words are.

The cassette interface transfers data and programs at 1500 baud. Motor control is provided and the whole thing worked reliably, although I found it was necessary to erase tapes before re-using them. This is probably due to the relatively high speed and short file headers used.

Although the two joysticks are optional extras, their interfaces are standard equipment. The joysticks return values between 0 and 63 in each direction and are also fitted with push-buttons.

The final interface provided is an RS232 serial port, intended primarily for use with a printer. A single handshaking line is provided, notionally Carrier Detect, but it could be connected to any appropriate signal. If the external device does not support handshaking Carrier Detect must be held 'high'. The firmware supports baud rates between 120 and 2400. Although the circuit provides for input as well as output, insufficient information is provided to permit the use of the port for input. In the US a Program Pak is available to turn the computer into a terminal for use with one of the dial-up networks operated by timesharing bureaux, although this requires a modem. This is no great strain on the pocket, since the Radio Shack modem sells for just \$149!

All connections are made at the back of the case, as are the on/off and reset buttons. The variety of sockets used makes it impossible to go wrong when connecting the system.

If anyone is particularly interested in

the details of the Color Computer's workings, *Byte* carried a detailed article about the machine ('What's inside Radio Shack's Color Computer?', by Tim Ahrens, Jack Browne, and Hunter Scales, March 1981, pages 90-130). I strongly recommend this article to anyone considering the purchase of a Color Computer, as it contains much useful information, such as instructions for increasing the internal memory to 32k, and how to use the expansion port. In fact, if I hadn't read it I wouldn't have known that there was an expansion port, as the manuals only describe its use as the Program Pak socket.

Software

As the list of keywords shows, Extended Color Basic has a lot in common with other Basics written by Microsoft. Numeric variables, for instance, are restricted to values between plus and minus $10^{3.8}$, and offer nine significant digits. Line editing is provided and a useful feature of the editor is that the line is listed automatically before editing starts.

Although it is not the slowest system tested by *PCW*, the Benchmark timings were particularly disappointing in view of the use of the 6809 processor. My guess is that this is a result of the low clock speed (0.895 MHz) rather than a fundamental weakness in the software. The *Byte* article includes a 'magic poke' to double the speed (except during cassette and other external I/O operations) but I cannot confirm its effect as I read about it after returning the test machine.

What is more important with a computer of this type is how well the hardware features are supported by the interpreter, and in my opinion the graphics functions are very powerful. I have never encountered such sophisticated graphics in a low-priced system. The lowest level of command simply turns a cell on or off but the more advanced features came as a real surprise.

The LINE command (as you would expect) draws lines between two specified points, or if only one pair of coordinates is specified, between that point and the previous endpoint. By using the options provided, it is also possible to erase a line (ie, draw it in the background colour) or to draw a rectangle, treating the endpoints as diagonally opposite corners. If desired, the rectangle can be filled in with the foreground colour.

I shan't spell out the function of CIRCLE, but it is also capable of drawing arcs and ellipses! Both LINE and CIRCLE permit the specification of a colour code.

To produce more complex shapes, DRAW is used. This command takes a string parameter which specifies the shape to be drawn. Movement may be to a stated coordinate or relative to the current position. 'Turtle'-like motion is also possible, but limited to eight directions. Additional flexibility is given by the ability to rotate or scale the shape, change colour, to move without drawing and to draw a line without updating the 'current' position. To increase the flexibility, the string may contain a reference to another one. This has a similar effect to GOSUB in a Basic program.

Once an outline is produced, there is no need to laboriously colour it in a dot or line at a time — simply PAINT it. This is used by specifying a starting point, the colour of the outline and the colour to be used. An invisible brush then does the work but not instantaneously — it takes about seven seconds to colour the whole screen.

Things now start to get very interesting for budding Walt Disneys. If you remember, it is possible to use several separate screenfuls of graphics. A single command copies the contents of one screen to another, which means that a static background only needs drawing once. Add the details to each 'frame' in turn, then flip from one to the next and you have an effective (but short) animated cartoon. Things could be made more complicated by replacing the delay loop that is needed between frames with the code to change the previous frame, but having only 16k of memory would preclude anything really fancy.

Another approach to animation makes use of the GET and PUT functions. GET copies a portion of a graphics screen into an array, and PUT replaces it, possibly in a different position. Once a block has been stored in an array, successive PUTs may be used to make the shape appear to be moving around the screen. When PUTting an array onto the screen it is possible to AND or OR the array with the current contents of the screen area. Other options allow the reversal of the array contents (ie, points that are set in the array are reset on the screen, and vice versa). If NOT is used, the contents

of the array are ignored and the screen area is reversed. The lack of memory becomes a problem when using GET and PUT, as each pixel is stored in a separate element of the array. This means that a block measuring 50 by 50 would consume about 10k of RAM! The manual suggests 1400 elements as a practical limit in a 16k system but if four pages of graphics memory were being used, there would not be room for much of a program.

Sounds (some people might say noises) may be added to a program by means of the PLAY command. Like DRAW, this is followed by a string literal or variable, which holds a series of codes to specify the desired sequence. To keep things simple, the letters 'A' to 'G' represent the notes of the same names, with '#' suffixed to indicate sharps, and '-' for flats. An alternative notation represents the scale from C to B by the numbers 1 to 12.

This easily-memorised notation extends to the length of notes ('L'), the octave to be used ('O'), volume ('V'), tempo ('T') and pauses ('P'). These instructions are all followed by integers representing the 'amount'. For example 'L1' specifies whole notes, 'L2' half notes and 'O3' the third octave. Dotted notes may be entered by placing a full stop after the length number.

New values for the octave, volume, length, and tempo may be defined relative to their current values. The symbols '+ - > <' increment, decrement, double, and halve the value respectively. I had some fun playing with this feature.

Other hardware features are

supported by appropriate commands and functions. The cassette recorder is controlled by MOTOR ON/OFF and AUDIO ON/OFF and, in addition to program and data files, it is possible to save and load memory-image files. Filenames of up to eight characters may be used, and SKIPF 'filename' advances the tape to the end of the specified file, although this is not usually necessary since CLOAD and OPEN search for the specified file. Unfortunately it is not possible to verify that a program has been saved correctly.

Other functions are JOYSTK (to obtain the position of a joystick), TIMER (which counts to 65535 in 1/60ths of a second), SOUND (generates a tone given the pitch and duration) and SET and RESET (to control the graphics blocks available on the text screen).

Useful facilities not found on all systems include program tracing, decimal to hex conversion and line renumbering.

Unless the computer was only intended for use with Program Paks, I would strongly advise the purchase of a system with Extended Color Basic, since the 'cooking' version of the interpreter does not allow the use of high resolution graphics, and PLAY and several other nice things are missing. Equally, a 16k system is essential for Extended Basic and it is needed in order to get the best from some of the Program Paks.

Program paks

Although I have not seen a full list of available Program Paks, the dozen provided are probably representative of the range. The target is clearly the home market — games predominate, but there are a couple of practical and educational programs.

Few of the games are unusual but they make good use of the graphics facilities. 'Quasar Commander' is a three-dimensional Star Wars style game which is made more difficult by the imposition of a time limit. The 3D animated graphics produced by 'Skiing' provide a good demonstration of the machine's potential in this area.

For sheer entertainment, my favourites were 'Pinball' (design your own table if you wish), and 'Dinowars'. This is a ludicrous game for two players, each using a joystick to control a Tyrannosaurus Rex, the object being to bite your opponent's beast on the back of the neck. Throw in a few cacti as obstacles and some blood-curdling roars and great fun will be had by all. It would be even better if the front-to-back resolution could be improved to make it easier to judge if your dinosaur is right behind your opponent's.

The quality of the keyboard makes 'Typing Tutor' difficult to assess. A better keyboard would make touch-typing easier but typing various permutations of 'ASDF' until your speed approaches a target soon becomes tedious. I suppose it depends how well motivated you are, but I doubt that commercial typing courses are quite as boring.

'Personal Finance' allows its user to prepare a month-by-month budget and to enter actual payments. The program provides for more than one bank account and data is stored on tape

Technical specification

CPU	6809E, 0.895 MHz.
RAM	16k dynamic, 4116 type.
ROM	16k (8k without Extended Color Basic)
Disks	available later
Cassette	1, software controlled, 1500 Baud
Serial Port	1, RS232 (simplified)
Screen	16 lines of 32 characters, uses colour TV.
Keyboard	53 keys
Languages	Extended Color Basic or Color Basic

Basic Keywords

ABS	AND	ASC	ATN	AUDIO	CHRS
CIRCLE	CLEAR	CLOAD	CLOADM	CLOSE	CLS
COLOR	CONT	COS	CSAVE	DATA	DEF FN
DEF USR	DEL	DIM	DLOAD	DRAW	EDIT
ELSE	END	EOF	EXEC	EXP	FIX
FOR	GET	GOSUB	GOTO	HEX\$	IF
INKEY\$	INPUT	INSTR	INT	JOYSTK	LEFTS
LEN	LET	LINE	LIST	LLIST	LOG
MEM	MIDS	MOTOR	NEW	NEXT	NOT
OFF	ON	OPEN	PAINT	PCLEAR	PCLS
PCOPY	PEEK	PLAY	PMODE	POINT	POKE
POS	PPOINT	PRESET	PRINT	PRINT#	PRINT@
PRINT TAB		PRINT USING		PSET	PUT
READ	REM	RENUM	RESET	RESTORE	RETURN
RIGHT\$	RND	RUN	SCREEN	SET	SGN
SKIPF	SIN	SOUND	STRING\$	STR\$	SQR
TAN	TIMER	TROFF	TRON	USRn	VAL
VARPTR					

between runs. The screen formatting is good and it is possible to re-define expense categories to suit your pattern of spending. A sign of the times is the presence of 'Alimony' as a heading.

If the Color Computer starts misbehaving, simply plug in the 'Diagnostics' pack, which checks memory, video and other aspects of the machine. It could be worth using regularly to ensure peace of mind but if you are going to pay to have the machine repaired, why bother?

Benchmarks (All times in seconds)

1	2.0
2	11.5
3	22.2
4	23.9
5	27.0
6	41.5
7	61.1
8	13.0

Documentation

Two manuals were supplied with the Color Computer. The Operation Manual is a clear, easy-to-follow guide to connecting the various parts of the system and what to do if it fails to work properly.

'Going Ahead With Extended Color Basic' is intended as a sequel to 'Getting Started With Color Basic' which I did

Memory map

-----	FFFF
I/O	-----
-----	FEFF
Program Pak ROM	-----
-----	BFFF
Color Basic ROM	-----
-----	9FFF
Extended Color Basic ROM	-----
-----	8000
-----	3FFF
Program and variable storage	-----
-----	35FF

Up to 8 pages of graphics screen RAM	-----
-----	05FF
Text screen RAM	-----
-----	03FF
System RAM	-----
-----	0000

not receive, due to the haste in which the computer was shipped over from America.

'Going Ahead. . .' is written in the usual light-hearted Tandy style. It is a tutorial book, containing plenty of examples, quizzes and programming tasks with model solutions. It's not the sort of thing you would give a professional programmer but just right for exploring the powerful (but not always simple) features of the language. To encourage the new user, there are some photographs (Color, of course) of displays which can be produced with the machine.

For the more experienced, appendices provide a summary of the Basic keywords, various tables (eg, ASCII codes), and instructions for using the I/O routines from machine code programs and for connecting non-standard printers.

A quick reference card is normally supplied. This would be very useful to prevent the manual becoming rapidly dog-eared.

Overall, the documentation is very well written, providing all the necessary information in a readable form, but the booklets supplied with the Program Paks are another story. I am not convinced that printed instructions are necessary for relatively simple programs (what's wrong with the screen?) but in any case they were not written as fluently as the major manuals. For example, in 'Typing Tutor' the pupil must plough through several pages of instructions before discovering that it is possible to change the 'pass level' which controls the progression to other keys.

Expansion

Apart from the conversion to Extended Color Basic and 16k of memory, no 'official' expansion is possible. As previously mentioned, it is possible to add a further 16k within the case of the Color Computer and a printer or other RS232 device could be attached, but that exhausts the current possibilities.

The operation manual makes fleeting

reference to a disk system and Tandy staff confirm that this will appear in due course. In America, Pertec markets an adaptor to connect a Color Computer to an S50 motherboard, which permits the use of a range of existing cards such as disk controllers, memory boards and other goodies. This adaptor has the ability to disable the on-board memory, permitting the assembly of a disk-based system with a minimal amount of ROM cluttering up the memory map.

It seems likely that other manufacturers will produce accessories and other products (including software) for the Color Computer in the same way as they have for other Tandy machines.

Potential

There can be little doubt that the Color Computer will be mainly used at home, being clearly aimed at the super video game market. However, it could find a niche in two other fields. Given suitable software plus some expansion, it has great potential in education as a visual aid, rather than as a computer proper — a poor man's PLATO, if you wish. But please, think before you buy for this purpose, as such software is not easy to produce, despite the power of Extended Color Basic. I also believe it could be purchased for use as a cheap colour graphics terminal. A Tektronix emulator Program Pak is likely to sell very well.

Conclusion

Given its reasonable price, the Color Computer seems destined to be another success for Tandy.

The forthcoming CBM VIC and Atari computers will prove formidable competition but the Color Computer should hold its own. The machine works and, within its limitations, anyone interested in graphics should have fun using it.

Prices (including VAT)

Color Computer, 4k RAM	£349
Color Computer, Extended	
Color Basic, 16k RAM	£449



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BENCH TEST



COMMODORE VIC

Commodore's VIC is a computer aimed straight at the domestic market. Featuring colour, sound and high resolution graphics it is competing with machines like the TI 99/4, the Tandy Color Computer and the Atari 400 and 800 but at a much lower price. David Tebbutt conducts the Benchtest.

The basic VIC comprises a full size keyboard mounted in a 16in by 8in cream-coloured case which also contains the processor, memory and various supporting chippery. It comes with a separate power supply, a video cable and a spiral-bound introductory book, all of which are included in the basic price of £189 including VAT. If you're interested in programming, you will certainly need a cassette recorder/player and these can be obtained separately from Commodore or whipped from the office PET. Thus armed, you can start to use what must be one of the best value-for-money machines around.

Non-programmers will be pleased to hear that they will be able to buy various pre-programmed cartridges which simply plug in the back. A well-written but poorly corrected manual gives an excellent introduction to VIC and to programming in general. I suspect Ramon Zamora of being the author of the book and, if my suspicions are correct, then there's probably no-one in the world better equipped to introduce computing to beginners. You see, he was one of the founders of ComputerTown, USA! and he's still very actively involved in

spreading the word.

An assortment of peripheral devices can be attached to the VIC, in particular joysticks, paddles, a light pen, a disk drive, a printer and a modem. Here I'm talking about what is possible rather than about what exists today. Later on in the Benchtest I'll give you an idea of when the various bits are expected to be available.

Hardware

The VIC is made of a sturdy plastic with a 65-key plain chocolate coloured type-writer-style keyboard plus four lighter coloured function keys. The whole appearance of the VIC is very pleasing and it certainly looked quite at home under my television in the living room. Each key has up to four functions which are activated by pressing them in conjunction with a shift key or the CTRL key. Apart from upper and lower case letters, the keyboard contains two sets of graphics characters (business and fun) and character colour control keys. Four function keys complete the ensemble to give up to eight user-programmable functions when used with the shift key. You may have

noticed there is no separate numeric keypad.

Six ports round the right-hand side and the rear of the VIC allow a number of devices to be plugged in. The games I/O is a standard nine-pin socket which can take joysticks, paddles or a light pen. (At the West Coast Faire I was amused to see an Atari joystick in use on the demonstration machine!) A memory expansion socket allows the insertion of games cartridges, special function cartridges and extra memory. After a while, keen programmers will need the extra since the VIC comes with only 5k of RAM of which you get about 3.58k by the time the system has grabbed its share for flags, pointers and the screen area. Memory is expandable up to 32k and to achieve this you'll need an expansion box because there's no room inside the VIC for any more chips. When you remove a plug-in cartridge you'll find it's pretty hot. This is because the VIC's massive heat sink surrounds the cartridge on three sides and there's hardly any room for ventilation. Fortunately, Commodore has designed the VIC so that, apart from the plug-in cartridge, there are no critical components near the heat sink.

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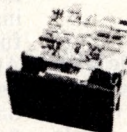
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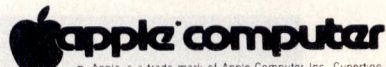
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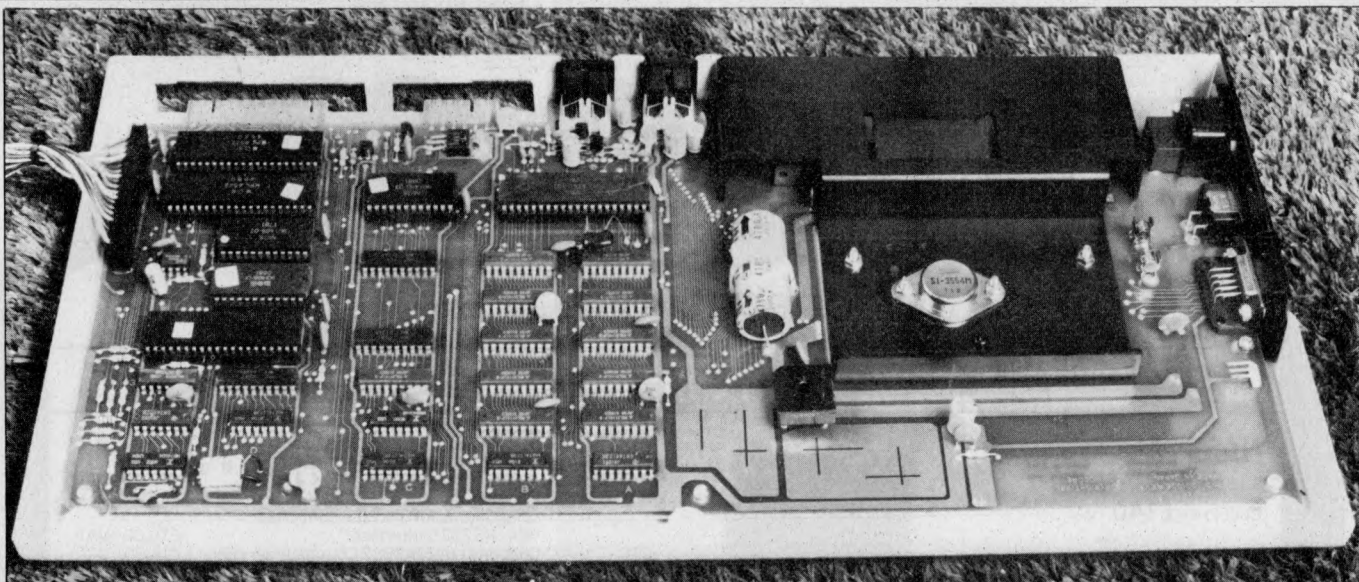
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Incidentally, the VIC is very clean and well made both inside and out and my guess is that if there are ever any problems with the basic unit then they will be caused by heat.

Continuing our tour of the ports we find the next one round is used for the television, carrying both audio and visual information. On my (fairly old) television the prototype VIC gave somewhat less than perfect colours, while on a friend's (much more modern) set the colours were brilliant. I must emphasise that the review machine was not a UK production model; I assume that production models will work on any PAL sets. We'll have to wait and see. The VIC screen can be considered in three parts: one is the central area where everything happens — this is called the background; the next is whatever you cause to appear in this area — usually characters; and finally the whole area is surrounded by a border. Up to 16 colours can be generated by VIC: the border can be one of eight colours, the background one of 16 and each character can be any one of eight. When using high resolution graphics, though, only two colours can be used (foreground and background). The screen layout is 23 lines of 22 characters or a theoretical 184 x 176 high resolution. (Each character is formed from an 8 x 8-bit matrix.) I say theoretical because another reviewer gives a different figure but I'm taking my information from the VIC hardware manual. Four channels of sound may be sent to the television — three voices (alto, tenor and soprano) and a fourth white noise. Just over three octaves can be played by POKEing numbers between 128 and 255 to appropriate locations while the volume can be varied from 0 (silence) to 15 (very loud).

The next port allows attachment of a printer or a disk drive, the one after that is for connecting the cassette and the final port meets the ubiquitous RS232C standard, although it really needs to be beefed up by an interface cartridge before connecting a modem, say, or a printer. I had no trouble at all using PET cassette recorders on the VIC for both saving and loading programs. A friend even tried reading VIC tapes on the PET and had no problems, although VIC-produced data tapes wouldn't load



Inside and outside the Commodore VIC.

on the PET for some reason. A special VIC recorder will be available at around £40 and it includes a tape counter.

At the heart of the VIC are a couple of important chips: one is the 6502 processor which drives machines like the PET, the Atari and the Apple to name but a few and the other is called (surprise, surprise!) the VIC, or Video Interface Chip. The VIC chip is the really neat one because it handles all the clever bits like sound, graphics, light pen and joystick interpretation. Of course this all has to be backed up by appropriate RAM, ROM and supporting chips. In fact, the VIC computer contains 20k of ROM chips which are dedicated to the Basic, the Kernel (called Kernal in most Commodore literature) and the character set. One of the nicest things about the VIC chip is that it contains a number of registers which control things like where the screen 'window' occurs on the TV, where the character set is and where the screen RAM might be found. Since these registers can be modified by the user, you can have a lot of fun with them. I'll come back to this in the software section of the review.

Printers are expected to be available at the VIC launch in August. These will be the 80 column, 30cps Seikosha models. The disk drives are expected in October and, while I don't know who's making them, I understand that they will be 5¼in, 170k capacity. The VIC will only handle a single drive, which might prove a trifle inconvenient but it would certainly be an improvement over cassette.

Software

Anyone familiar with the PET will feel very much at home with the VIC. The Basic is version 2.0; this is what has become known as 'new ROM' among PET aficionados. That, coupled with the keyboard arrangement and graphics characters, brings on severe attacks of the 'deja vu'. What can I say that's original? The Basic is a good Microsoft implementation and the extra bits, like sound and colour, are achieved by a series of POKEs, unless you happen to have a special 'Super Expander' plug-in cartridge, in which case you'll find you get special Basic extensions. Some 'music' commands would have been most useful in the basic machine but then I guess that it's easier to swipe an existing Basic ROM from PET rather than develop a new one.

The Kernel (I'm sticking to the English spelling even if I'm wrong) is the bit between Basic and the hardware. This introduces some features which weren't present on the PET. Most of them relate to what happens when you hit various keys, so this seems a sensible place to start the explanations. For a start, you'll notice that some of the keys repeat automatically. This is darned useful when editing a program, since all the cursor movement keys do it. A bit of probing around the Commodore documentation tells me that it's possible to make all keys repeat, but I couldn't make it happen. Believe Commodore, not me! Using the Commodore logo key, it's possible to switch between upper/lower case with business graphics and upper case only

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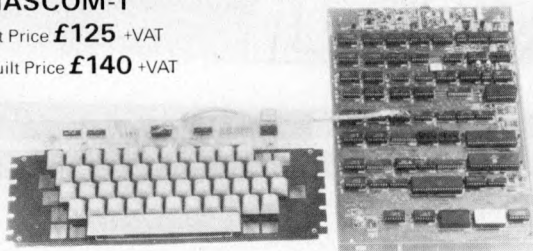
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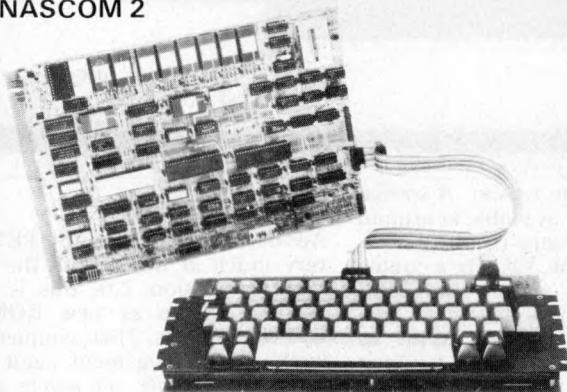
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with full graphics. I think the idea of the two working modes is excellent and the implementation was well thought out. The CTRL key can be used to slow scrolling or to select character colours when used with the numeric keys. The VIC maintains a screen position colour table so that each character on the screen can appear in any one of eight colours. It is possible to get out of an awful crash by hitting RUN/STOP in conjunction with RESTORE. This resets the machine but retains the program in memory. Unlike the PET and many other machines the INPUT instruction is now bomb-proof. This means that you can hit RETURN and stay in your program. If you really wanted to break the program at this point then you can do it by pressing the right shift key in conjunction with RUN/STOP, which is just above the left shift key. (No prizes for guessing why it doesn't work when you press the left shift — yet another example of the thought that went into the VIC's design.)

Let's return now to the VIC chip and see what mischief we can get up to. We can cause explosive effects by poking bit three of one of the registers and we can generate all manner of noises by poking others but the best fun of all can be had by playing around with the registers which point to various key bits of the memory. Since you can redirect the character set pointer you can make it point to some characters that you've designed. Presto! — user-defined graphics. If you want to, you can poke another register to make the system think that the characters are all double height. If you do this without moving the character set pointer, then you'll find that if you press '@', for example, you will actually see an '@' with an 'A' immediately below it. This is because on the VIC the letter '@' is code zero and letter 'A' is code one. Since the double height tweak causes the character generator to take double the number of bytes (16 instead of eight) from the character table, you always get two consecutive letters from the table. Of course you can turn this to advantage and get yourself a screenful of high resolution graphics by redirecting the character table pointer to an area in memory where you're going to create a number of double height characters. When you start the exercise, this area will be clear and each character position on the screen will point to a separate 'character' in the table. When you want to plot something on the screen, you work out which byte of which character is being displayed at that screen position; you then AND it with a mask containing the bit to be set. The result is put back in the character table, thus causing an instant change to the display. The double height character representation is necessary because the system can only refer to 256 different character codes and there are 506 normal character positions on the screen. Since each screen position is supposed to be displaying a different character in the set, it's clear that there wouldn't be enough normal-sized characters to fill the screen. If that seems like a load of gibberish to you then don't worry, when you get your VIC you'll get my drift. Suffice it to say that by fiddling around with the user definable character potential you can

actually wangle high resolution graphics. I know, I did it (with tons of help from Paul Higginbottom's notes on the subject and Andrew Goltz's tireless patience with me one Saturday night. Both these gents work for Commodore; thanks a lot, chaps). The only problem is that you need extra memory to implement this fully, since 256 characters each of 16 bytes is something like 4k, and how much memory did I say the basic VIC has got for the user? Unless you've got serious objections you may as well buy a £35-odd 'Super-Expander' plug-in cartridge which has an extra 3k of RAM, plus all sorts of built-in functions like CIRCLE, PLOT, PAINT, TEXT, HIRES and even some other bits and pieces like MUSIC, SOUND, PIANO and TEMPO. I was supplied with this cartridge but no documentation so I only managed to get as far as playing the piano, plotting and drawing circles.

For those who enjoy messing around with programs, Commodore is bringing out a 'Programming Aid' cartridge which includes a programmer's tool kit and a monitor. For those who don't enjoy messing around with programs, Commodore is bringing out a whole range of arcade, educational and home utility cartridges. I had the good fortune (or was it misfortune?) to receive a copy of a fiendish game called Galaxians. One thing is certain, I lost almost a weekend of good Benchtesting time playing this darned game. It's similar to our old friends the space invaders: the aliens march to and fro across the screen, not getting any lower but peeling off from the top and swooping down diagonally across the screen dropping a lethal cargo of atomic bombs as they go. The aliens keep returning to the top of the squadron unless they are actually shot down by one of your rockets. You have no protection, only your speed and an endless supply of rockets. If you get hit then you are replaced by a fairly realistic mushroom cloud accompanied by a sound like a flushing cistern, prior to being given you next life. The aliens can come from either side of the screen, both single and in convoy, and as your score mounts so the frequency of attack increases while at the same time your rocket gun takes longer to reload. The noises which accompany the game seem to be specially formulated to induce panic and it's all I can do to survive two squadrons of aliens before losing my third (and final) life. Great fun. Not a reason to buy a VIC of course, but a must if you've actually bought one.

Documentation

The main working text is a two-colour print job with a cover depicting a 'family' grinning inanely at a screen with a budget program 'displayed' on it. The fact is that no-one would be that enthusiastic about such a program and, anyway, there's no power plug in the VIC so it's all a put-up job. They were probably watching the Muppet Show or something. The book is introduced as 'A friendly computer guide' and it's certainly that. After the first chapter the others can be taken in any order that takes your fancy. Interested in graphics? — then try that; music? — then there's a chapter on that too. It's

a neat way to organise a book. Each chapter starts off with a program to be keyed in 'to see what happens'. The rest of the chapter is devoted to explaining what you did and to introducing related ideas. There are small programs all over the place and lots of encouragement to experiment. The emphasis of the book is on enjoyment and the approach is very similar to the way Ramon runs ComputerTown in Menlo Park. The book does get a bit syrupy at times with things like: 'Amazing. Your VIC is full of wonderful features', or, following the reader's name being displayed on the screen, 'Wow! Now that you're a TV star...' Ugh!

The two-colour printing works well because the book is sprinkled with little blue clouds containing comments relating to the more formal black text. A program listing, for example, might have accompanying blue clouds saying what the functions of the more obscure lines are. I sat two of my children down with the book for an hour each. The ten-year old got on just fine and managed just over a chapter. The eight-year old finished the first program in the chapter and found it pretty heavy going. Unfortunately, both of them encountered mistakes which would have left them high and dry had we been beginners. This is a shame because it is so easy to get 'Gladys' or someone to

Benchmark timings (in seconds)

BM1	1.4
BM2	8.3
BM3	15.5
BM4	17.1
BM5	18.3
BM6	27.2
BM7	42.7
BM8	9.9

Memory Map

FFFFH	----	Kernel ROM
E000H	----	Basic ROM
C000H	----	Expansion ROM
A000H	----	I/O 3
9C00H	----	I/O 2
9800H	----	Colour RAM
9400H	----	I/O 0
9110H	----	VIC address
8FFFH	----	Character ROM
8000H	----	Expansion RAM/ROM
6000H	----	Expansion RAM/ROM
4000H	----	Expansion RAM/ROM
2000H	----	Screen
1E00H	----	User Basic program
1000H	----	3k Expansion RAM
0400H	----	Working RAM
0000H	----	

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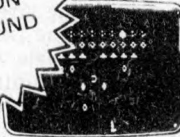
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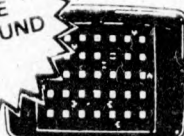
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Technical specification

CPU	1 MHz 6502
Memory	20k ROM, 5k RAM (expandable to 32k)
Keyboard	65 keys, typewriter style and pitch
Screen	Domestic TV, 23 rows of 22 cols, 184 by 176 high resolution, 16 colours
Cassette	PET-compatible or VIC cassette
Ports	Games I/O Memory expansion Audio/Video Peripheral I/O Cassette User

Prices and availability

In view of the fact that the pound is sinking fast, by the time you read this the prices may have been adjusted.

	Price (in £ including VAT)	Approximate availability
Basic VIC	190	August
3k RAM	25	August
8k RAM	35	September
16k RAM	45	September
ROM cartridges	18-50	From August
Expansion box	100 (my guess)	September
Cassette recorder	40	August
Disk drive	less than 300	October
Joysticks/paddles/light pen	no idea	October
Printer	200	August
Programmer's reference guide	about 15	August
Programmer's Aid	35	August
Super Expander	35	August
RS232 Interface	50 (my guess)	September
IEEE 488	no idea	soon
ROM emulator*	200	August

*The ROM emulator is a rechargeable battery powered 16k RAM cartridge.

work through the printer's proofs of such a book. I know there's never enough time but what about all those poor novices out there, completely stuck because too little care was taken in the initial stages of a project which, frankly, wouldn't have suffered seriously from even a week's delay while someone checked the book.

Well that's the first manual and it was a great effort, marred by a certain lack of care when it mattered most. Programmers who want to find out more about the machine will find the Programmer's Reference Guide very good. It gives the answers to all the more detailed questions which crop up once you get under way. At the moment, work is still being done on a UK version but the draft I received was pretty good. The thing which I felt was lacking was a detailed memory map although I was subsequently able to get hold of one which was drawn up by Jim Butterfield. I hope that this is included in the final version. Also, at the back, some notes made by Paul Higginbottom came in extremely useful and some supplementary notes from the same man received a few days later cracked the high resolution graphics problem mentioned earlier. Once again I hope that Commodore includes at least the key points from these two documents. The main body of the book is taken up the various Basic commands and how to use them, plus a description of all the user-callable machine code routines.

I was also loaned a servicing manual and, for me anyway, the most interesting bit was the specification document for the VIC chip. For the engineers among us it did give things

like circuit diagrams and waveforms to be expected at various diagnostic points in the system. I'm not really sure that I'm qualified to comment further on that particular book.

I've not inspected every piece of Commodore literature over the years but I must say that this is the best I've seen from the company so far.

Who'd use it?

This is almost a daft question because the VIC seems to scream 'home user' at you from the moment you first see it. I'm sure, though, that educational establishments who were thinking of going the Sinclair route might stop and think again. I can't see the machine being used in business in any big way but if you happened to have one knocking around I reckon that uses could be found for it, especially when presenting information in the form of



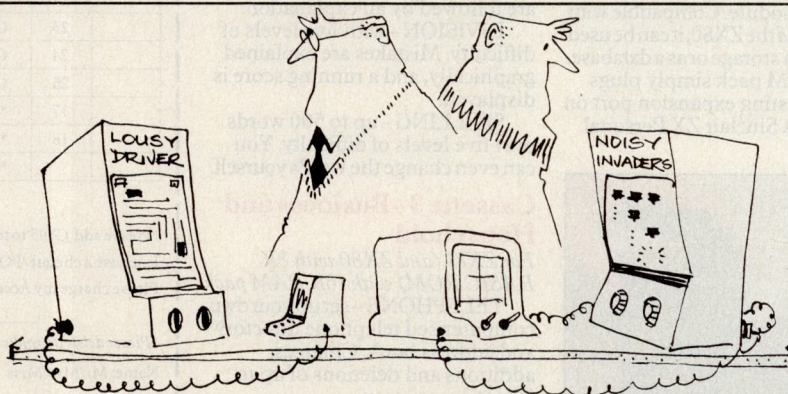
Random selection of VIC colours.

charts and histograms. So I'll put my money on home and education as prime users of this equipment. In order for this to happen Commodore and friends have got to put a lot of work into software development. At the moment the majority of people buying it will be the computer cognoscenti who will actually be able to do something with it, despite the initial lack of off-the-shelf programs.

Conclusions

Commodore has come up with a very neat, budget-priced micro which offers colour, a four-channel sound and plug-in program cartridges as standard. For a little extra money you can buy a high resolution graphics module and then you're beginning to talk about a very nice piece of kit. The memory on the basic machine is very limited and I think that another 3k wouldn't have hurt anyone too much. As it is, this can be bought as an extra. There are a few machines which take the VIC approach; the ones we have Benchtested are the TI 99/4, the Tandy Colour Computer and the brace of Ataris. The VIC is priced well below all these and, while it doesn't offer the sophistication of the TI or Atari graphics, it's not that far away for everyday applications. The Tandy machine is reviewed elsewhere in this issue and I haven't studied the review yet, so I'll leave it to you to draw the necessary comparisons there. What I'm driving at is that I think Commodore has got it right. At a price of less than £200 you're getting a very smart machine, one which can grow as your needs grow.

My thanks to Commodore and especially to Andrew Goltz who did a fair amount of running around on my behalf, as well as being on the receiving end of all sorts of strange questions.



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TWENTYONE – a dice version of Blackjack.

COMBAT – you're on a suicide space mission. You have only 12 missiles but the aliens have unlimited strength. Can you take 12 of them with you?

SUBSTRIKE – on patrol, your frigate detects a pack of 10 enemy subs. Can you depth-charge them before they torpedo you?

CODEBREAKER – the computer thinks of a 4-digit number which you have to guess in up to 10 tries. The logical approach is best!

MAYDAY – in answer to a distress call, you've narrowed down the search area to 343 cubic kilometers of deep space. Can you find the astronaut before his life-support system fails in 10 hours time?

Cassette 5 – Junior Education: 9-11-year-olds

For ZX81 (and ZX80 with 8K BASIC ROM)

MATHS – tests arithmetic with three levels of difficulty, and gives your score out of 10.

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Some of the more elaborate programs can be run only on a Sinclair ZX Personal Computer augmented by a 16K-byte add-on RAM pack.

This RAM pack and the replacement ROM are described below. And the description of each cassette makes it clear what hardware is required.

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The 8K BASIC ROM used in the ZX81 is available to ZX80 owners as a drop-in replacement chip. With the exception of animated graphics, all the advanced features of the ZX81 are now available on a ZX80 – including the ability to run much of the Sinclair ZX Software.

The ROM chip comes with a new keyboard template, which can be overlaid on the existing keyboard in minutes, and a new operating manual.

16K-BYTE RAM pack

The 16K-byte RAM pack provides 16-times more memory in one complete module. Compatible with the ZX81 and the ZX80, it can be used for program storage or as a database.

The RAM pack simply plugs into the existing expansion port on the rear of a Sinclair ZX Personal Computer.



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ORBIT – your space craft's mission is to pick up a very valuable cargo that's in orbit around a star.

SNIPER – you're surrounded by 40 of the enemy. How quickly can you spot and shoot them when they appear?

METEORS – your starship is cruising through space when you meet a meteor storm. How long can you dodge the deadly danger?

LIFE – J.H. Conway's 'Game of Life' has achieved tremendous popularity in the computing world. Study the life, death and evolution patterns of cells.

WOLFPACK – your naval destroyer is on a submarine hunt. The depth charges are armed, but must be fired with precision.

GOLF – what's your handicap? It's a tricky course but you control the strength of your shots.

Cassette 2 – Junior Education: 7-11-year-olds

For ZX81 with 16K RAM pack

CRASH – simple addition – with the added attraction of a car crash if you get it wrong.

MULTIPLY – long multiplication with five levels of difficulty. If the answer's wrong – the solution is explained.

TRAIN – multiplication tests against the computer. The winner's train reaches the station first.

FRACTIONS – fractions explained at three levels of difficulty. A ten-question test completes the program.

ADDSUB – addition and subtraction with three levels of difficulty. Again, wrong answers are followed by an explanation.

DIVISION – with five levels of difficulty. Mistakes are explained graphically, and a running score is displayed.

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Cassette 3 – Business and Household

For ZX81 (and ZX80 with 8K BASIC ROM) with 16K RAM pack

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SOF09

UP THE SHARP END

David Hunt, Managing Director of DDT Maintenance discusses the realities of keeping that micro on the road.

'Power to the People' is one of those hackneyed phrases usually associated with revolution and, by TV buffs, with Wolfie Smith and his Tooting Popular Front. Hackneyed or not, no other phrase is so apt at summing up the role of the microcomputer in modern day society and, with apologies to Wolfie, this power is very real and the revolution a lot more far reaching than anything that's happened recently in Tooting. The microcomputer makes computing power available to people in all walks of life; owning a computer is now a viable proposition for small businesses, educational users, council departments, libraries. . . the list goes on ad infinitum.

As with most of the good things in life there just has to be a catch. In the case of the low cost business micro-computer system it's 'how do you get it fixed if it goes wrong?' Microcomputer-based systems have a degree of sophistication which would have seemed unthinkable only a few years ago. Powerful application software packages are available off-the-shelf and yet the whole business of using the micro-computer has been simplified to the point where it can be considered as just another business aid, much like the electronic calculator. Optional peripherals abound; printers, VDUs, disks, tape, and all at relatively low cost. But 'how do you get it all fixed?'

As systems become more powerful and able to take over more aspects of particular operations, so the dependence of users on these systems will increase. As systems become lower in price (and they are, in inflation-relative terms) so the number of dependent users will increase. Any business or organisation planning its operation around a micro-computer system where a real degree of dependence is foreseen, would be unwise to consider the cost of maintenance in isolation from the initial purchase price. With the the ratios are such that maintenance should be considered as a component part of the total cost of the system and

not as a subject to be discussed after the decision to buy a particular system has been made.

Maintenance contracts on the larger computer systems are easily obtained from either the initial supplier or an independent (third party) maintenance organisation. The ground rules covering such contracts are well defined and years of experience ensure that the contracts work to the mutual benefit of both parties. Around 12 percent (give or take a bit) of the initial purchase price will buy a comprehensive on-site service contract with a reasonable response time. The 12 percent also offers the maintenance organisation a fair return and justifies the trained personnel and adequate spares holding necessary to the smooth running of the contract. Thus, in the world of the larger computer, the ongoing cost of an installation is relatively small compared to initial price and everyone is fairly happy with their lot.

In the world of the business micro the ground rules are not so well defined, the experience is lacking, and maintenance can become a problem for the unwary. The micro-system may be just as essential to the smooth running of the small organisation as the large computer and 12 percent of not much is even less. In absolute terms, 12 percent of the micro price is hardly likely to excite the maintenance company and yet the micro user can need just the same response as his large computer counterpart. It is obvious that, in order to arrive at a satisfactory solution, both the user and the maintenance company must rethink the approach. The user must avoid the pitfall of thinking of the micro rather like he does his car; get the best deal on the price of the car and worry about maintenance costs afterwards. Better think of the micro like getting married; the initial cost isn't that much but the ongoing costs sure push up the real price.

The maintenance company for its part needs to prune overheads to suit the market, yet without compromising

service standards. However, it is not sufficient just to cut a penny here and a penny there. A fundamental change of approach is dictated and requires that savings be made through economy of scale. Selling maintenance contracts direct to individual users using the traditional 'door knocking' method is just not on since the cost of sales alone would burden any subsequent contract to an unacceptable degree. A far better way is to sell the contracts via the dealers and distributors, which substantially reduces the sales overheads and diverts money into something of real value to the user, ie, improved service. The other benefit is, of course, a considerable increase of potential contracts on like hardware, making the holding of a good spares inventory a worthwhile proposition.

Other complications in micro maintenance are not so obvious. By definition, many new users have little or no experience of computer equipment or the handling of the various input/output media. Thus the maintenance company must allow for more 'finger trouble' than is normal. The environment can range from back sheds to plush offices, and the potentially destructive contaminants from splinters in the printer to coffee in the floppy (I bet the latter one rings a few bells among any service engineers reading this!!). For all that, the micro system can still be critical to the total operation and excessive downtime cannot be tolerated. The same type of contract as for the large computer is needed, ie, 12 months parts and labour with a guaranteed 24 or 48 hour response. Multi-user micro systems, increased throughput with the advent of 16 bit and 32 bit micros, and more powerful software, will mean even greater dependence on the micro and consequently same-day response will become more and more of a real requirement. No matter how effective is the economy of scale, the maintenance company cannot hope to provide all this for 12 percent of 'not much'. Further-

GOTO page 166

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DOMINOES

David Levy presents the last article in his present series

This month sees the final article in the present series on computer games, in which I have tried to cover a wide cross-section of games that require some measure of intellectual ability, and have attempted to include a number of general principles that might be of use in programming an even wider variety of games. In this month's article I shall describe how to write a program to play dominoes, using principles encountered earlier in the series.

At first sight, dominoes is not a particularly demanding game, but to play really well requires a combination of deep calculation and a certain measure of memory. In one respect the game is very similar to backgammon — luck plays a big part, but the skilled player can play with the odds and come out on top in a long series of encounters.

How to play a simple version of Dominoes

A set of dominoes may be compared to a deck of cards, with 'suits' and 'denominations'. In most countries the domino set comprises 28 dominoes, each of which has two numbers painted on it. The numbers lie in the range 0 through 6, and no two dominoes have the same two numbers. Thus, the complete set comprises:

6-6	6-5	6-4	6-3	6-2	6-1	6-0
5-5	5-4	5-3	5-2	5-1	5-0	
	4-4	4-3	4-2	4-1	4-0	
		3-3	3-2	3-1	3-0	
			2-2	2-1	2-0	
				1-1	1-0	
					0-0	

The concept of a suit is somewhat strange in dominoes: we may refer to all the dominoes containing a 6 as the 6-suit, but of course this suit will also contain a domino which may be found in the 5-suit, one which may be found in the 4-suit, etc.

Countless games may be played with the set of dominoes. Here I shall describe a very simple game which I used to play as a child.

All dominoes are turned face down and shuffled, and each player picks seven dominoes at random, which he then looks at. The game may be played with two, three or four players, but I always found the game with two players

was the most challenging and the most enjoyable. There is some method for deciding who goes first — this may be done by the toss of a coin, or it may alternate from one game to the next, or it can be the player who holds the highest double (in which case this double must be played on the first move). Once a domino has been placed on the table, face up, the players take it in turns to move.

In order to make a move a player must put down a domino which has, as one of its numbers, the same number as one of the ends of the chain of dominoes already on the table. The new domino is put on the table in such a way that the matching parts of the two dominoes are next to each other. The other end of the new domino then forms a new end to the chain. Whenever a double domino is placed on the table it is put at right-angles to the end of the chain whose number matches the double. The following example illustrates the first few moves of a game.

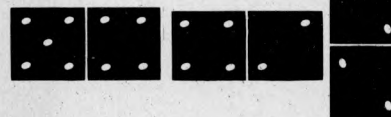
The first player (who won the toss) puts down the 5-4:



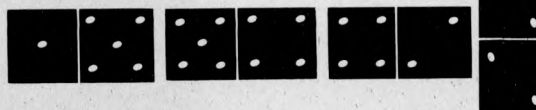
The second player puts the 4-2:



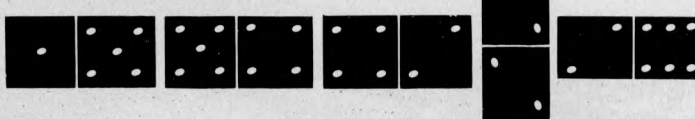
The first player puts the 2-2:



The second player adds the 5-1:



The first player places the 2-6:



Thus the game progresses, until the player whose turn it is to move cannot put a domino from his own hand at either end of the chain. He must then pick up dominoes from the shuffled set one at a time until he gets one which may legally be played at one end of the chain. The first player to get rid of all his dominoes wins the hand, and his opponent is debited by the number of points showing on all the dominoes remaining in his hand. It is customary to play until one player's total reaches a certain threshold, say 101, and he loses the game.

Playing strategy

The game may conveniently be split up into two distinct phases and we shall briefly consider the second phase first. Once all the dominoes from the shuffled set have been taken into the players' hands, it is easy for the players to deter-

mine exactly which dominoes are held by his opponent. (Of course, in a three or four-handed game it is usually not possible to determine where the remaining dominoes lie until later in the game, when each player has only two or three dominoes left. Then it will usually be possible to deduce which players have which dominoes from a knowledge of which players 'passed', ie, indicated that they had no legal move.)

In a two-handed game, once you know which dominoes remain in your opponent's hand, it is relatively easy to search the game tree that includes every possible way in which the remaining dominoes can be played by each side. Since the average number of legal moves at the closing stage of the game is roughly two, the size of the whole of the game tree will be roughly 2^{14} terminal nodes, and so using the alpha-beta algorithm will enable the program to search this tree while examining only 100-200 terminal nodes. The evaluation function should reflect the method of

scoring by assigning to each terminal node the number of pips on the remaining dominoes in the hand of the player who loses. Thus pips in the user's hand will be measured on the scale of positive integers, those in the computer's hand will be negative integers. Since your computer will be able to calculate and search the game tree more quickly and more accurately than human players, there is considerable scope for your program to defeat a human from a theoretically losing position, since the program will always play the endgame perfectly, whereas a human will sometimes miscalculate.

The program can increase its advantage in the endgame in certain situations where it has more than one move which will, with best play, lead to the same result. It can choose the move which, in some sense maximises the probability that its opponent will make a mistake. The simplest way to do this is to choose

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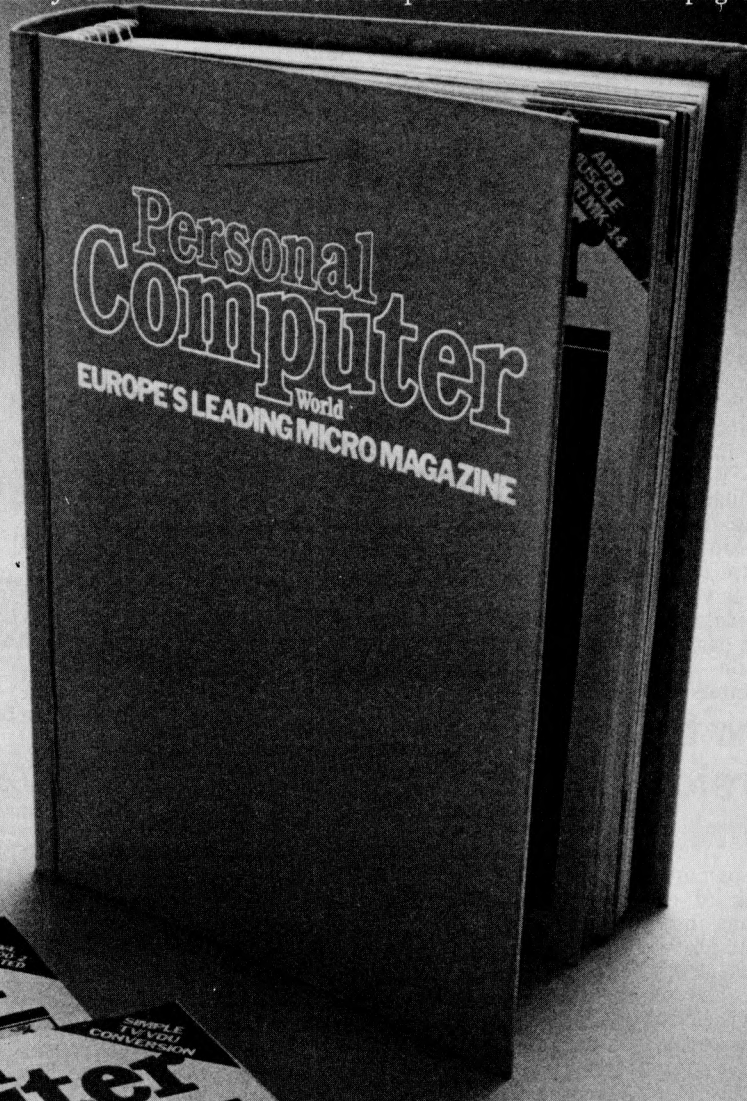
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whichever move will lead to the best score if the user makes the smallest mistake possible during the remainder of the game. If the moves still appear to be of equal merit, assume that the user will make the second smallest mistake possible, and so on. This optimistic modification to the traditional method of searching the game tree is not dissimilar to Donald Michie's technique for assuming imperfect play on the part of the opponent, which was mentioned in an earlier article.

A more difficult problem to solve is how to decide what move to make in a pre-endgame situation, when the program does not know exactly which dominoes are held by its opponent. The strategy here is similar to the one employed in some of the card games discussed earlier. The program begins the game with the knowledge that each unseen domino has the same probability of being in the user's hand and then these probabilities are adjusted in the light of experience (ie, which dominoes are played by the user and in which situations the user is forced to take dominoes from the shuffled set). Let us see how this method works by examining the first few moves of a sample game. We shall assume that we are playing the version in which the player holding the highest double makes the first move.

The program is dealt the following seven dominoes:

6-4 6-1 5-3 5-0 3-3 3-0 2-1

The user does not have the double 6, and so asks the program 'Do you have the 6-6?' When the program replies 'No', the user puts down the 5-5. Immediately the program assigns a probability of zero to the 6-6, since it is certain that the 6-6 is not in the user's hand, and all the remaining unseen dominoes have a probability of 0.3 (6/20), since the user now has six dominoes and there are 20 unseen dominoes, excluding the 6-6 which the program knows is not in the user's hand.

The program must now decide between playing the 5-3 and the 5-0, and it is here that we must employ some sort of evaluation function. What are the features that we should consider for such a function?

It is clear that one important aspect of dominoes lies in trying to prevent your opponent from putting down one of the dominoes in his hand, thereby forcing him to pick up from the shuffled set and putting off the time when he will have got rid of all his dominoes. So one feature must relate to the probability that the user will be able to put down a domino from his hand on the next turn. If the program now plays the 5-3, the user will have to play a 5 or a 3. The program can calculate the expected number of 5s and 3s in the user's hand simply by adding together the probabilities for the 5s and 3s. Similarly, the program can calculate the expected number of 5s and 0s (in case the program decides to play the 5-0). We shall call the expected number of moves by the opponent E.

Another important feature is the probability that after the user has moved the computer will have a legal move at its disposal and this feature should reflect the fact that the program would like to have as wide a

choice as possible. This feature can also take advantage of the probabilities, albeit in a more complicated manner, as can be seen from the following discussion.

If the program plays a 5-3, the user has a number of theoretically feasible plays at his disposal. If we denote the dominoes assumed to be playable by $D_a D_b D_c D_d \dots$ etc, and the probability of the user having each of these dominoes in his hand is denoted by $P(D_a), P(D_b), P(D_c), P(D_d) \dots$ etc, then by making the approximation that the user is equally likely to make any of the legal moves at his disposal, we can derive the following measure for the expected number of legal moves at the program's disposal after the user's next move if the program chooses 5-3 at this move:

$$P(D_a) \times N_a + P(D_b) \times N_b + P(D_c) \times N_c + P(D_d) \times N_d + \dots \text{etc,}$$

where $N_a, N_b \dots$ etc, are the number of moves at the program's disposal should the user choose to play domino a, b ... etc. (Note that in certain circumstances one domino can be played at either end of the chain, for example if the ends of the chain are a 6 and a 1, then the 6-1 domino can be played either way round. Each of these plays should be counted as a separate play for the purpose of counting the values of the $N_a, N_b \dots$ etc.) We shall call this expected number of legal moves for the program EP.

One other feature which is useful to take into consideration is the number of pips on each of the dominoes that the program can play in a given situation. Since the losing player in a hand is penalised to the extent of the pips on his remaining dominoes, it is obviously a useful generalisation to play the domino with the highest pip count, all other factors being equal. But since this heuristic would result in very predictable play on the part of the program, in a way which an intelligent human opponent could use to his advantage, it would be wise to vary the play of the computer slightly by ensuring that a measure of randomness was used in the decision-making process. I would suggest that when the computer was ahead in the hand, ie, when the user had picked up more dominoes from the shuffled set than had the computer, then weighting for this pip feature should be small, so that the program might play less predictably. When the program was doing badly, the weighting for this feature should be relatively large, so that if the user won the hand (as might seem likely) the program's loss on that hand would be minimised. When neither side seemed to have any advantage in a hand, the weighting should be somewhere between the two. We shall call the number of pips played PP.

Our evaluation function now looks like this:

$$(W_1 \times \text{opponent's expected number of legal moves}) + (W_2 \times \text{computer's expected number of legal replies}) + (W_3 \times \text{number of pips played on this move}) \text{ or, more symbolically:}$$

$$W_1 \times E + W_2 \times EP + W_3 \times PP$$

Adjusting the probability table

After each play by the user it will be necessary to adjust the table of pro-

babilities for all the remaining unseen dominoes. Obviously we gain the greatest amount of information when the user cannot make a move without picking up from the shuffled set, because at that time we know that he does not hold any of the dominoes which can legally be played. We therefore set the probability for each of these legal dominoes to zero, and normalise the probabilities for the remaining dominoes. We also learn a certain amount when the user actually plays a domino — he no longer has any likelihood of holding that domino in his hand since it is now on the table, so its probability is set to zero and again the remaining probabilities are normalised. In addition to these rather obvious situations, there are other occasions when the program can derive useful information from the user's choice of which domino to play.

Let us assume, for example, that the ends of the chain show a 3 and a 1, and that the program has previously shown itself to be out of 1s (having picked up from the shuffled set at a time when both ends of the chain showed a 1). Then, if the user does not play the 3-1 on the 3, which would be sure to deprive the program of a move and compel it to pick up dominoes ad nauseam, then it is safe to assume that the user does not hold the 3-1 (unless he is an idiot). The probability for the 3-1 can therefore be set at zero and the remaining probabilities normalised. When considering such situations, the program should ensure that a play such as the 3-1 will not deprive the user of any legal moves, unless the user would then have many fewer dominoes than the program, in which case, with neither side being able to move, the computer would lose the hand.

For those readers who feel that the strategy described so far is lacking in real sophistication, there is one further refinement which would make the program outstandingly strong, but for the move execution time to be realistic your program would need to be written in assembler language. When the user has made a move, if the program has a choice of reply it should perform the following calculations.

For each and every possible combination of dominoes in its opponent's hand (of which there will never be more than about 39,000), the program should compute the scores which it will assign to each of the user's legal moves, and convert these scores into probabilities, by normalising them. It will then have, for each possible user holding, the probability with which each move would be made. The program then looks at the move actually made by the user, and uses Bayesian probability to determine the probability that the move actually came from each of the possible holdings. Finally, knowing the probability that the user actually holds each of the possible holdings, the program can calculate a much more accurate estimate for the user holding each of the unseen dominoes that could be in his hand. This series of calculations can be done when the user makes his first free choice of play (ie, ignoring situations in which the user moves first), and can retain this information throughout the hand. After

GOTO page 167

MULTI-USER BENCHTEST

HMSOS

Adrian V Stokes continues our series with an in-depth look at a multi-user operating system for the North Star Horizon

In June, we reviewed a multi-user operating system called MP/M. The system we are reviewing in this current Benchtest is similar in concept but has many differences in practice.

The essential concept of MP/M and HMSOS is that they are both based on a well-known, commonly available operating system; in the case of MP/M, this is CP/M; for HMSOS, it is North Star's DOS.

There are two major points of dissimilarity. MP/M is intended to be a multi-user operating system for many environments. HMSOS is intended also to be a multi-user operating system but specifically designed for supporting a number of applications — as the name suggests, its first major use was for a hotel system. The second major difference is that HMSOS seems to live up to much of its promise whereas, as our previous review indicated, MP/M has many features which are not so desirable and we understand that the entire MP/M system is currently being rewritten.

Due to the availability of a wide range of hardware (and software), we took the opportunity of performing, not only the usual Benchtests but a wide range of other measurements using our standard multi-user Benchmarks.

Overview

HMSOS is 'a modified multi-user version of North Star DOS. . . The HMSBasic interpreter is a modified North Star Basic interpreter'. The modifications are such that, in most cases, programs written for a standard North Star system should run unaltered or, perhaps, with a minimum of alteration, on HMSOS.

The modifications to DOS are, in general, those needed by the multi-user capabilities of the system and we describe these in detail below. Similarly, the modifications to Basic are those needed for a multi-user system but also some new functions have been included, making it of more use in a commercial environment. Also, some cosmetic

changes have been introduced.

The system has some additional features which are also valuable, especially a spooler for the printer. HMSOS supports a wide variety of backing storage devices from double-density mini-floppy disks to 25 Mbyte hard disks.

Hardware

The basic hardware for HMSOS is North Star Horizon with a few modifications to the configuration as normally supplied.

The modifications required are the provision of bank-switched memory and the requisite number of additional I/O interfaces and ports. Also, the machine (which is usually supplied with interrupts disabled) has to be wired to permit various interrupts, particularly a 27 millisecond clock interrupt. These changes are fairly simple and involve cutting a few jumpers and wiring up some DIP headers.

The system runs very much more efficiently (as shown below) when using a hard disk and various such disks are supported (especially the 26 Mbyte Discus 14in drive and the 8in 10 Mbyte Winchester). Within the very near future, it is also proposed to support a 5.25in mini-Winchester with either 5 or 10 Mbyte capacity! Of course, it supports the standard North Star disks (5.25in hard-sectored floppy disks) with the exception of single-sided, single-density. It also supports 40-track and 80-track Tandon double-sided disks. Finally, utilities are provided for backing-up the hard disk to the DEI 6400 bpi cartridge tape (two tapes for the largest disk, one tape otherwise).

The hardware supplied to us for the Benchtests consisted of the Horizon, suitably wired, together with two double-sided, double-density Shugart drives. In addition, a rather strange VDU — the Pericom 6800 — was loaned. Unfortunately, time did not permit an examination of the many features provided by this VDU and it was merely used as a non-intelligent terminal.

Various other VDUs were used at stages of the Benchtests. In addition to the loan of the above system for long enough to examine the system in some detail and to do the standard Benchtests, Hotel Microsystems Ltd and their neighbours, Dentron Computers Ltd, made various other equipment available at their premises (especially a hard disk system) enabling a fairly thorough investigation to be undertaken.

Software

HMSOS is a multi-user operating system based on North Star's DOS, with much of the North Star code and, particularly, entry points, retained. Clearly the addition of bank-switching, activated by a clock interrupt, requires additional interrupt routines and these are provided. It is based on North Star DOS Version 5.1DA with the operating system located at address 0H and Basic (currently the only language available) at 1000H up to 4000H. These programs are re-entrant and do not reside in bank-switching memory.

The user's programs are located from 4000H to a maximum of DFFFH (ie, from 16k to 56k), although it is not necessary to provide all this memory, if a smaller system is required. System utilities reside in the 'Transient Program Area' which overlays part of the user memory from 6000H to 7FFFH (thus implying that each user requires a minimum of 32k virtual machine).

Thus, a layout of memory for a four-user system might be as in Figure 1.

The reason for the maximum memory being 56k is that the North Star disk controller is memory mapped, residing at E800H and, although it is possible to put memory around this that is, from 56k to 58k and from 60k to 64k, it is rarely, if ever, done except for special purposes (for example, the Hi-Tech Colour VDU board which was recently reviewed in PCW is memory-mapped and occupies 2k — this may be positioned conveniently from 56k to

SYSTEM MEMORY...USER MEMORY...DISK
CONTROLLER

DOS. BASIC...

USER 1 (56k)

USER 2 (48k)

USER 3 (32k)

USER 4 (32k)

Fig 1

58k (E000H to E7FFH)).

A printer spooler is available and this is implemented merely by changing an entry in the user's I/O table (described in the manual). It also requires a hardware modification but, if the system is supplied by Hotel Microsystems, this is likely to have been done before delivery.

A related and very useful feature is that of 'pseudo-keyboards'. These are pseudo-devices allowing communication with 'background' jobs, that is, jobs which are not attached to a specific terminal. There are certain problems in using these devices, particularly if the job attempts to write to its VDU (which it hasn't got), thereby slowing down the system noticeably. As the major use of HMSOS is for applications programs; these facilities are likely to be hidden from the users and should not cause trouble.

Another useful feature is the ability to map between virtual disk drives and real. In North Star DOS, access to disk is by real addresses; in HMSOS, the logical number specified in the program may be mapped onto whatever real devices are available, leading to more flexibility in writing programs.

We have already stated that HMS provides a modified Basic. A fairly minor modification is to change one of the system parameters which defines the user's memory size to a pointer to a table of memory sizes as there may now be multiple users (although it should be emphasised that, while HMSOS is a multi-user system and this review is looking at it in that context, it may be used as a single-user system and, in some circumstances, may be a preferred alternative to North Star DOS).

Various cosmetic changes have been made — for example, North Star's FILL and EXAM have been replaced by the more conventional (although perhaps less informative) PEEK and POKE. HMS provides three versions of Basic and they all have these changes. However, one version of Basic is specially modified, in addition, to provide a number of interesting functions which are of considerable use in a commercial or systems environment. These functions include ones to manipulate dates and a very powerful string search facility. In order to accommodate these new functions some of the standard functions of North Star DOS have been removed. These are the scientific functions such as SIN and LOG and, should they be required, they are provided in the second version of Basic supplied. The third version is similar but is intended

for use with the additional (North Star) floating point board.

One major addition is the ability to interface conveniently to assembler language programs. North Star Basic provides a rudimentary facility whereby an assembly language program can be called with a single (16-bit) argument and returns a single result. HMSOS provides a facility (originally available in Ashley Allen's PDS system) whereby any number of parameters can be passed to the assembler program. One argument is passed in a register pair, the remainder on the stack (leading to chaos if the wrong number of arguments are POPped off the stack within the program) and the result is passed back in a register pair and may be assigned to a variable.

By itself, this is a valuable feature but of restricted use. A second feature which greatly increases the power (also available in PDS), is the ability to pass the address of parameters (call by reference rather than call by value). This is denoted by enclosing the variable in square brackets and is particularly useful in the case of strings.

A final addition to the assembler language interface is the provision of a routine allowing the user to load his own assembler utilities. The syntax of such a call (showing, as well, the other two features mentioned) is: I-CALL (LOADF, A, [A\$], 0) where LOADF is a value (currently 004AH) of the routine's address, A is the destination address and A\$ is a string containing the filename of the program to be loaded.

Various other, minor, improvements have been made to North Star Basic and DOS.

Input/Output

One of the major problems in a multi-user system is that of input/output (or, as it is now colloquially known, transput) both to the standard devices and so to files. The problem is quite simple — if two users try to access the same device, there must be some mechanism whereby they cannot harm each other's data. For example, if both are reading a file, no harm will result. If one is reading a file and the other is writing, some problems might occur as it is probably indeterminate whether the reader will obtain the new or the old data; but these can be overcome. If one user wants to write to another user's console, other problems might occur as the destination user might not want to be interrupted; on the other

hand, this is a very valuable communication mechanism and should not be prohibited altogether.

HMSOS recognises these problems and has solved them in a fairly sensible way but one which assumes co-operation between the authors of software which runs on the machine at any one time. Essentially, the solution is to provide functions to LOCK and UNLOCK files. However, there are two disadvantages. First, these statements only work on channel number (0 to 7) and not to files; so two programmers can totally circumvent the interlocks by referring to the same file by two different channel numbers. Secondly, to quote from the documentation, 'locking a file only prevents another user from locking it, not from accessing it. The programmer must ensure that all critical areas of programs where files are updated must be enclosed within LOCK/UNLOCK statements.'

Thus, the safety of one user's files depends on the good programming practices of all the other users of the system and this is a potentially dangerous feature. Perhaps in the specific environment where HMSOS is used for specific applications programs (and thus the end-user never sees the operating system) or where all users of the system are running the same program, this is not likely to cause difficulty but it seems the weakest feature of the system.

Documentation

There is little need for documentation for HMSOS. It is likely that the hardware will be appropriately configured when purchased and, in many cases, the user will not need to write any programs.

The documentation supplied with the system consists of a short (29 page) description of the changes between North Star DOS/Basic and HMSOS, together with information on reconfiguring the system and usage of the various backing storage devices.

To a highly qualified programmer (as many of the users of this system will be) this is adequate, although the organisation of the document could be improved (even by the addition of a list of contents and separators between the sections). To a novice programmer, it is likely that the documentation will be of little value as he will need to cross-reference continually to the North Star documentation. Ideally, a rewritten North Star manual for this system is needed so that the user is given a description of the system he buys rather than a basic manual with a list of changes. However, the resources needed for this are quite considerable and could well be out of the reach of a small company without significantly increasing the price of the product.

The description of the hardware changes is not too clear (once again, the layout is probably mainly to blame). This should not cause many problems since the user is likely to buy the system already configured from Hotel Microsystems or, if not, should be able to understand the manual after reading it once or twice.



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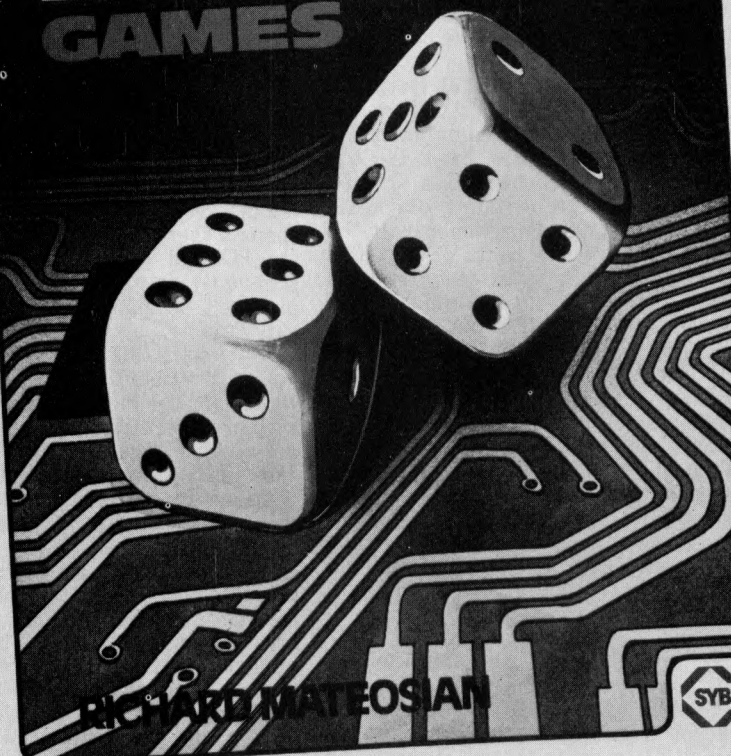
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TEST	PROG 1	PROG 2	PROG 3	PROG 4
1	38.5	280.6	20.8	31.0
2	36.1	280.2	20.6	30.8
3	38.5	121.1	19.4	23.6
4	36.1	121.1	19.2	20.7
5	39.4	122.0	20.0	25.6
6	37.1	122.0	19.8	22.7
7	40.2	93.2	8.5	26.0
8	78.2	245.0	41.7	50.4
9	16.8	121.6	19.6	10.8
10	17.1	92.1	7.6	11.1

Table 1

Problems encountered

Very few problems were encountered in performing the Benchtests. A most peculiar fault manifested itself when the first Benchtest failed and, after investigation, the problem seemed to occur in a perfectly legitimate line, namely a DIM statement. Other statements also failed and, after a short while, it became apparent that the disk had become corrupted. This was sorted out by Hotel Microsystems extremely quickly.

The only other problem encountered was when using a particular VDU which required the interface to be wired up differently. This, of course, would not occur if all the hardware was bought from the company (nor, indeed, if the reviewer had stated the precise requirements of his VDU).

PCW Benchtests

As in previous Benchtests, a set of four programs were used under various circumstances. These tests are designed to show particular aspects of the system and they did this very clearly.

In the current Benchtest, it was decided to extend the range of the tests quite considerably as a reasonably

large range of hardware was available. In all, each test was run under ten different circumstances, which were as follows:

1. Standard North Star DOS using double-density, single-sided drives and, of course, a single user. In addition, the VDU used was only running at 2400bps;
2. As the above but with the programs 'compacted', that is, with all non-significant spaces and so on removed (a listing of the standard Benchtests for the Horizon and the compacted versions are given in Table 2). The compaction is performed automatically by a general purpose formatting program;
3. As (1) but using a 9600 bps VDU and double-sided, double-density drives. Although the use of the second side of the drives was not relevant; the actual drives are able to step between tracks very much faster than their single-sided counterparts and this is shown clearly in the results;
4. As (3) but using the compacted programs;
5. As (3) but using HMSOS rather than North Star DOS. The system was configured for two users but only one user was active;
6. As (5) but using the compacted programs;
7. As (5) but using a Shugart 5008

14in 26 Mbyte hard disk;

8. As (5) but with two users;

9. As (5) but with the programs compiled rather than interpreted. This was possible due to the provision by Hotel Microsystems Ltd of a system called COMSTAR which is a North Star compatible Basic compiler (in fact, it generates source assembler which may then be assembled and linked);

10. As (9) but using the hard disk.

Clearly, more combinations were possible but the above serve to show many of the relevant features.

The results that were obtained were, perhaps, entirely predictable but this, in itself, is a most valuable result. They were as shown in Table 1.

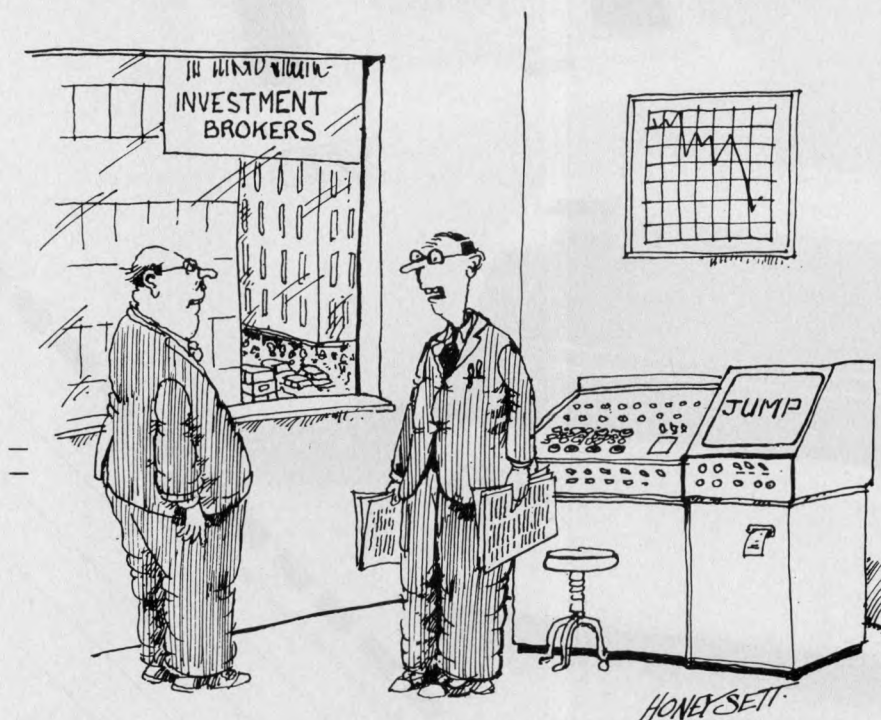
It should be emphasised that, despite the figures being given to the nearest tenth of a second, the timing was performed by the use of a stopwatch and such accuracy was probably not possible. (However, all tests were timed at least twice.)

The first item to notice from the table is that the use of a compacted program, even when the original program is quite small and has little extraneous information (such as comments which would have been removed by the compaction program), makes an appreciable difference. From personal experience of this program (which was written by the reviewer over a year ago), its use in cases of larger programs makes a very significant difference in computing speed and, of course, allows the program to occupy much less space on disk — typically half.

Of course, taking this to an extreme and using the compiler rather than the interpreter makes a very significant change in the case of programs which are CPU bound but, in the cases where the program is I/O (disk) bound, there is very little to be gained. The gain in programs 1 and 4 (comparing tests 4 and 9) is a factor between two and three but, according to Hotel Microsystems, a factor of up to eight can be recorded in other programs.

A comparison of test 1 and 3 shows that the use of a faster VDU is only of significance where the program is heavily I/O bound and makes no difference in other cases. However, the very dramatic change in time when running program 2 is clearly due to the faster disk drives. In essence, Program 2 (which performs two loops, the first opening a file, writing a line, then closing the file, the second doing the same but reading instead of writing) involves large movements of the disk head since opening and closing the files requires access to the first sector on the disk (the catalogue) whereas reading and writing involves access to the file. It must be pointed out that the time for this test is very heavily dependent on the position of the temporary file on the disk and no attention should be paid to the absolute value of the time; on the other hand, the comparisons are valid since the file was positioned at the same place on the disk (although this is not true for obvious reasons when the hard disk was used).

Comparing tests (3) and (5), North Star DOS against HMSOS for a single



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Model 460 – features a nine wire staggered head for enhanced print quality.



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Company _____

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user, shows that there is a small overhead in using the multi-user system but this is so small that it is unlikely to be significant in most applications.

Using the multi-user operating system but a hard disk as backing storage gives a very large gain in efficiency in the case of a heavily disk-bound program (Program 2) but it is interesting to note that there is a small loss of efficiency in the case of the two I/O bound programs and this is probably due to the increased overheads in the operating system for the hard disk. In any case, these are not particularly large. A similar pattern shows between tests (9) and (10) where the compiled programs are used.

Finally, the major point of this Benchtest: the comparison between one and more users. In this case, the comparison is between one and two users (test (5) and (9)). Once again, the results are as expected: a doubling of the times for all the tests on doubling the number of users from one to two. In the case of Program (4) which is I/O bound, the time is not quite doubled but very nearly so. This implies that the system is efficient at handling I/O and does not wait for output to be completed before switching to the next user (this, of course, is clearly stated in the manual).

Thus, to summarise, the system in its many implementations performs very much as expected and leaves no nasty surprises for the users.

Availability and costs

HMSOS is an entirely British system and is supported from the company's offices at 69 Loudoun Road, London NW8 0DQ (Tel: 01-328 8737). On visiting the offices, I was given all the help I needed (but then reviewers nearly always are!). However, on overhearing various telephone calls while I was there, I got the impression that the current users of the system were given a similar degree of help.

The system is available (end-user price) for £175 for the floppy-disk system or £275 for the hard-disk version. It is likely that the intending user would buy the hardware as well as the software and an all-inclusive price would be negotiated, although there is no reason why a user who already has a North Star Horizon should not buy the software alone. The hardware would require some minor modifications and various new items are required, such as the bank-switching memory boards and additional I/O interfaces.

Although the system is a multi-user system, the modifications made to North Star DOS and Basic are themselves valuable and it would seem valuable if a single-user system were marketed at a Microsystems and they have indicated that they would consider it if there were enough demand.

Summary

HMSOS is a fairly straight forward multi-user system with all the features that are required and few extra frills. This could be considered rather unexcit-

ing but users, on the whole, prefer reliability to excitement.

The system performs as expected with no obvious bugs and, on looking at the actual code, seems a well designed and competently written system.

Table 2: Benchtest programs

```
1000 !"S"
1010 K=0
1020 DIM M(5)
1030 K=K+1
1040 A=K/2*3+4-5
1050 GOSUB 1120
1060 FOR L=1 TO 5
1070     M(L)=A
1080 NEXT L
1090 IF K < 1000 THEN 1030
1100 !"E"
1110 STOP
1120 RETURN
1130 END
```

```
1000!"S"
1010K=0
1020DIMM(5)
1030K=K+1
1040A=K/2*3+4-5
1050GOSUB1120
1060FORL=1TO5
1070M(L)=A
1080NEXT
1090IFK<1000THEN1030
1100!"E"
1110STOP
1120RETURN
1130END
```

PROG 1 (compactd)

```
1000 !"S"
1010 CREATE "TEMP",2,20
1020 DIM A$(128)
1030 A$=""
1040 FOR I=1 TO 128
1050     A$=A$+"A"
1060 NEXT I
1070 FOR I=1 TO 100
1080     OPEN E1%20,"TEMP"
1090     WRITE E1,A$
1100     CLOSE E1
1110 NEXT I
1120 FOR I=1 TO 100
1130     OPEN E1%20,"TEMP"
1140     READ E1,A$
1150     CLOSE E1
1160 NEXT I
1170 !"E"
1180 END
```

PROG 2

```
1000!"S"
1010CREATE"TEMP",2,20
1020DIMA$(128)
1030A$=""
1040FORI=1TO128
1050A$=A$+"A"
1060NEXT
1070FORI=1TO100
1080OPENE1%20,"TEMP"
1090WRITEE1,A$
1100CLOSEE1
1110NEXT
```

```
1120FORI=1TO100
1130OPENE1%20,"TEMP"
1140READE1,A$
1150CLOSEE1
1160NEXT
1170!"E"
1180END
```

PROG 2 (compactd)

```
1000 !"S"
1010 CREATE "TEMP",100,20
1020 DIM A$(128)
1030 A$=""
1040 FOR I=1 TO 128
1050     A$=A$+"A"
1060 NEXT I
1070 OPEN E1%20,"TEMP"
1080 FOR I=1 TO 100
1090     WRITE E1,A$
1100 NEXT I
1110 CLOSE E1
1120 OPEN E1%20,"TEMP"
1130 FOR I=1 TO 100
1140     READ E1,A$
1150 NEXT I
1160 CLOSE E1
1170 !"E"
1180 END
```

PROG 3

```
1000!"S"
1010CREATE"TEMP",100,20
1020DIMA$(128)
1030A$=""
1040FORI=1TO128
1050A$=A$+"A"
1060NEXT
1070OPENE1%20,"TEMP"
1080FORI=1TO100
1090WRITEE1,A$
1100NEXT
1110CLOSEE1
1120OPENE1%20,"TEMP"
1130FORI=1TO100
1140READE1,A$
1150NEXT
1160CLOSEE1
1170!"E"
1180END
```

PROG 3 (compactd)

```
1000 !"S"
1010 FOR I=1 TO 100
1020     FOR J=32 TO 96
1030         ! CHR$(J),
1040     NEXT J
1050     !
1060 NEXT I
1070 !"E"
1080 END
```

PROG 4

```
1000!"S"
1010FORI=1TO100
1020FORJ=32TO96
1030!CHR$(J),
1040NEXT
1045!
1050NEXT
1060!"E"
1070END
```

PROG 4 (compactd)

NEWS DIGEST

Could a Computer Locate Lord Lucan? To find out whether a microcomputer could succeed where Interpol had failed, *MicroComputer Printout* magazine commissioned a psychological profile of the missing Earl. A program was developed which would compare this with profiles of different countries and predict Lucan's whereabouts. Ex-Detective Superintendent Roy Ranson, who headed the police investigation, found the computer's prediction "far from outlandish. I certainly wouldn't dismiss it." Full report in the August issue of *MCP*.

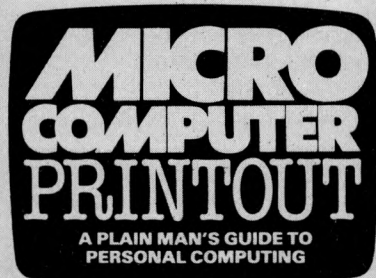
Which are Britain's Best Programs? *MicroComputer Printout* asked a panel of distinguished micro-persons to nominate their Programs of the Year. Some of the results - *MicroModeller*, *Unix*, *Silicon Office* - were not unexpected; but which well-known pundit voted for *Space Invaders*? And why did a prominent editor nominate the naughty *Interlude* program? Answers to all this, and more in the August issue.

Bionic Briefcase baffles buggers, hinders hijackers, homes-in on hostages. In the August issue Bernard Levin reports on the bullet-proof briefcase that will scramble telephone calls, detect bugs and explosives, monitor conversations, ward off attackers, sound a screaming siren if stolen, and then track itself down. One drawback: there is no space left for sandwiches.

Turtle teaches children to program. A remarkable computer language, the principal feature of which is a robot turtle, is being hailed by American educators as the solution to many teaching problems. Its inventor, Professor Seymour Papert of M.I.T., describes the Turtle as "an object to think with". Now the LOGO language is being introduced for microcomputers with a screen version of Turtle Graphics. Details in the August issue.

Other stories in the same issue include **Choosing a Cheap Computer**, with the lowdown on five inexpensive systems, **Checkmate!**, a battle between the best-selling *MicroChess* program and a new challenger, *PetChess*, with a commentary by two International Grand Masters. Plus **Prestel on the PET**, **6502 Assembler for Beginners**, **How to Buy a Printer**, **Building with Program Bricks**, **How BASIC Works**, news, gossip, and special programming advice for PET users.

MicroComputer Printout isn't just for PET owners; it is for anyone interested in understanding more about microcomputers, especially beginners. We even write it in English! To subscribe costs just £11.40 for 12 issues*, or for a sample copy send £1 to *MicroComputer Printout*, P.O. Box 48, Newbury RG16. All orders should be prepaid by cheque, postal order, Access/Mastercharge/Eurocard or Visa.



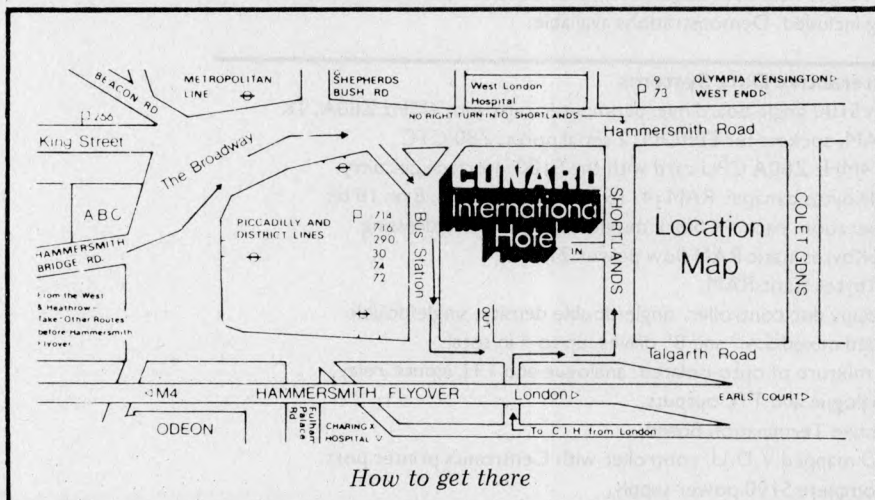
*Europe £17.40; Eire £18.15; USA \$36; Rest of World £16.50 surface or £30 airmail. Subscriptions are for the twelve issues of the current volume (relevant back issues will be sent) unless otherwise requested. Also available: *The PET Companion* a book containing all the editorial from the first volume, price £9.95 inc. postage (USA \$25; Europe £12). Credit card orders accepted by telephone on 0635-201131.

The 4th Personal Computer World Show

10-12 September
Cunard International Hotel
London

Here are the final details of Britain's best microcomputing show. This year we're making sure there's something for everyone by splitting the exhibition over two floors. Upstairs the emphasis will be on serious stuff while downstairs

it will shift to fun. If you're a businessman, bring the kids and leave them downstairs while you are looked after upstairs. If you're a kid then why not bring dad along? — he'll probably enjoy the show just as much as you will!



How to get there

G19, G20

Acorn Computers
27 Bridge Street, Cambridge
Tel: 0223 62780

Acorn's main attraction is the new BBC microcomputer, made under licence to BBC Enterprises. The Atoms, Acorn's personal computers, will also be on display.

The Atom is simple to operate in its basic form but is fully expandable with the range of Acorn Eurocards. High resolution colour graphics and word processing facilities will be demonstrated.

Acornsoft Ltd, a subsidiary of Acorn Computers, will be showing its range of software, including games, word processing, mathematical and scientific programs.

A7

Arfon Microelectronics Ltd
Cibyn Industrial Estate, Caernarfon,
Gwynedd, Wales. Tel: 0286 5005

Arfon Microelectronics is a new company which employs the knowledge and proven design success of people who

have been at the forefront of micro development in the UK.

Based in Caernarfon, Arfon sells built and tested products throughout Europe, producing both 'house products' and products from other companies. To be launched at the show are the speech synthesiser board and the light pen.

Arfon would like to hear from any company with a design or manufacturing need related to its own business.

T5, T6

Avalon Computers and Communications/ Wordsmiths
19a West End, Street, Somerset
BA16 0LQ

Avalon will display its range of 6502-based computers including the Tangerine personal and industrial units and Tantel Prestel adaptor, some Acorn systems and the full Ohio Scientific range. In conjunction with Mutek and Ohio Scientific UK, it will demonstrate an integrated business package running on a hard disk-based Ohio Scientific system.

Wordsmiths will present the Anvil system, a typesetting service for

For those who would prefer to stand back and be amazed, we are once again running a microcomputer chess championship. This year it's the Second European Championship and for those unfamiliar with these things, the computers actually vie with each other for the awards.

Newcomers might be interested in ComputerTown and the computer club stands (G17) or, if your interest is more serious, you might like to have your questions answered by the National Computing Centre's qualified consultants (Stand B50). Schoolteachers might care to drop by the Houghton County Primary School stand (G17) on Friday or Saturday to learn how they're getting along with micros.

The show will be an exciting blend of hardware, software, accessories, peripherals and books. It's your opportunity to get to grips with the micro business, make contacts — and enjoy yourself!

The show will open from 10 am to 7 pm on Thursday and Friday. On Saturday it will still open at 10 but will close at 4 pm. Admission is £2 (accompanied children under eight get in free) but elsewhere in this issue there's a voucher which will get you in for £1.50 if you cut it out and bring it with you. The Cunard International Hotel is in London's Hammersmith, just a stone's throw from the underground station where the Piccadilly, Metropolitan and District lines run. It is also well served with buses and, once you're there, you need not step outside since the hotel has a selection of bars and restaurants as well as the usual snack bar within the exhibition itself.

Don't forget to drop by the PCW stand where we will have enormous stocks of magazines and binders. You might even find an editor or two lurking around, although we can make no guarantees about their sobriety or otherwise.

We look forward to seeing you at the show. We know you'll enjoy it.

Stop press:

too late to get into the following round-up is Encotel Systems Ltd, stand B2.

computer users. This gives users of any type of word processor easy access to a quality phototypesetter and combines word processing with typesetting for simpler production of rate tables, directories, etc. Purpose-built terminals for use with this system will be available at the show.

A25

Beta Systems
4 Upper Tachbrook Street, London
SW1V 1SH. Tel: 01-834 3442

A comprehensive selection of application packages and products will be viewed on this stand, mainly on the Apple and Texas Instruments and principally in Basic and Pascal.

Well-known names include Visicalc, Micromodeller, Versawriter and Tridee. Beta will also exhibit its own program for rotating part of a picture.

B48

Business Electronics
Rowhams House, Rowhams,
Southampton SO1 8AH.
Tel: 0703 738248

Details not available by press date.

CODIFIED COMPUTER SYSTEMS

DAI

£595 Personal Computer with high specification & "real world" expansion.

Easy to program 16 colour graphics with sound.
Socket for printer on RS232 port, also stereo output.
DAI "real world" industrial control Eurocards plug into the DCE bus.
The machine has 48K and a thriving user group is providing software.
As the CPU is the 8080, CP/M (TM) and discs arrive in a couple of months.

OSCAR

£2495 British made commercial computer (with 800K diskette storage)

By Interactive Data Systems of Milton Keynes. Providing as standard 64K, Z80 CPU card with 2 serial ports and 2 spare slots in its S100 bus. Discs are 8", 5" or Winchester. The CP/M operating system means that a mass of written software and facilities are available in addition to the supplied software for sales, purchase & nominal ledgers plus payroll.

PERT

£205 Program for PETS. 1200 activities under 400 cost codes

Keyboard entered networks give a critical path, fixed & free float and earliest/latest start/finish times. Reports (screened or printed) give activities in node/calendar sequence, with float selection by cost code and period. Activity costing & targeting included. Demonstrations available.

S100 Cards

Interactive Data Systems

£235	SBMC	An S100 single board microcomputer card with 4MHz Z80A, 1K RAM, sockets for EPROM, 2 serial ports, Z80 CTC.
£105	Z80 CPU	A 4MHz Z80A CPU card with the S100 interface circuitry.
£450	64K DRAM	64Kbytes dynamic RAM (4116) with bank select, 8 or 16 bit operation, each 4K block deselectable, 24 bit addressing.
£198	16K SRAM	16Kbytes static RAM (low power 2114's)
£114	8K SRAM	8Kbytes static RAM.
£198	D.F.D.C.	Floppy disc controller, single/double density, single/double sided mixed 5¼" and 8" drives, up to 4 in total.
£223	PCI 10	A mixture of opto-isolated, analogue and TTL inputs; relay, analogue and TTL outputs.
£32.50	TERM 40	Active Termination Board.
£265	VID 1	I/O mapped V.D.U. controller with Centronics printer port.
£155	PSU	Complete S100 power supply.
£88	PSUC	Power Supply Card.
£75	PSUT	Power Supply Transformer, bridge, capacitor, cables.

Dual

£135	CLK-24CPU	An S100 real time clock-calendar card with a battery on the card giving a typical readout like THURS 8-1-81 3:55:21
£355	AIM-12	An S110 A/D card with 16 or 32 input channels giving 12 bit resolution and accuracy.
£245	AOM-12	An S100 D/A card with 4 output channels/actuators with an accuracy of 12 bits +/- 0.5Lsb.
£165 4K	CMEM	An S100 CMOS 200ns memory card working at 4MHz. The battery back up will enable data or program to be held for up to a year.
£290 8K		

Matrox

£176	ALTR2480	An S100 TV CRT controller displaying 24 x 80 of alpha or graphic data.
£235	ALT256	An S100 256 x 256 graphics controller stackable for multiple grey/colour effects using X-Y addressing
£343	ALT512	As the card described above but 2 graphics modes, 512 x 256 or 256 x 256 x 2 giving live animation effects.

**15 Newington Green,
London. N16. Tel. 01 254 7419**

Micro Computer systems,
S100 IEEE Cards & Peripherals.

Codified Computer Systems
supply British in London.

B55

Cetronic Ltd,
Hoddesdon Road, Stanstead Abbots,
Ware, Herts SG12 8EJ.
Tel: 0920 871077

This company will exhibit its 'P' range mains voltage conditioners, designed to overcome irregular voltage supply and transient interference, common problems when using small computers.

Benefits include protection of micros from overloading during a fault condition, prevention of VDU flicker and screen drift and complete isolation between mains and computer.

Also on display will be the CO30C Absolute Optical Shaft Encoder with a specially designed PET interface for communication with mechanical systems. This will give an accurate digital shaft position signal by resolving 360 degrees of mechanical rotation into 256 bytes. Many applications are possible in the field of position control and mechanical data logging.

B26, T4

Chromasonic Electronics,
48 Junction Road, London N19 5RD.
Tel: 01-263 9493/5

Details not available by press date.

T17

Circolec (Electronic Games Shop),
1 Franciscan Road, London SW17.
Tel: 01-767 1233

Circolec is a professional electronics company with tremendous experience in servicing all types of electronic games for major manufacturers.

Its subsidiary, the Electronic Games Shop, was formed in 1980 to sell leading brands of chess computers, TV games and hand-held games. Only established names are sold at the most competitive prices.

Circolec will exhibit a wide range of computer games at special show prices, including the Morphy Encore chess computer, probably the strongest fixed program machine available.

G14, G12, A3

Commodore Business Machines (UK) Ltd
818 Leigh Road, Slough, Berks
SL1 4BD

Commodore will show products for all levels of computer user from first-time user to educational user and enthusiast.

On the ground floor will be the VIC 20 colour home computer, the 8096 Virtual Memory Machine and the MMF 9000 96k RAM machine.

On the second floor, business applications such as accounting, payroll, word processing and stock control will be demonstrated and advised upon. Commodore will also be on-line to a remote mainframe, showing how a micro can work alongside other facilities.

B15

Community Computers,
PO Box 3, Petersfield, Hampshire,
GU32 2ER. Tel: 073087 567

The principal distributor for Cameo Electronics, Howard Industries and other leading micro peripherals in the UK will be exhibiting the new NEC PC

8000, operating with the Cameo/Western Dynex hard disk system.

Also being exhibited for the first time will be the DataMac software package featuring the CP/M operating system and the MDBs database. This software has been developed over a five-year period specifically for businesses requiring job costing to be integrated into their accounts systems.

The Howard Industries ET221 Type-printer for word processing will also be on show with the Apple and the NEC PC 8000.

G34

Compshop Ltd,
14 Station Road, New Barnet, Herts
EN5 1QW. Tel: 01-441 2922

Compshop will bring a wide range of computers and accessories for viewing. The TRS-80 Model III will be on show, as will computers from the Video Genie and Apple ranges and the hand-held Sharp PC1211. Prices will be at discount rates for the duration of the show, especially on Compshop's own product, Compukit.

B19

Computer Bookshop
Temple House, 43-48 New Street,
Birmingham B2 4LH

Details not available by press date.

G17

ComputerTown UK!
c/o 14 Rathbone Place, London
W1P 1DE

ComputerTown UK! is a nationwide network of autonomous computer literacy centres. Volunteers bring computer literacy to their own communities by taking machines and programs (either their own or those borrowed from or donated by local owners/dealers) to a community focal point — library, church hall, etc — and making them available free of charge to any interested persons who come along. Since CTUK! was launched in November 1980, over 20 centres have opened across the country. News of CTUK! is published regularly in PCW and occasionally in other magazines.

Whether you want to play, make contact or just plain talk, come along to the ComputerTown stand and find out what it's all about.

T7

Computer User Aids,
9 Moss Lane, Romford, Essex RM1 20B

Computer User Aids provides a friendly and personal service to anyone interested in microcomputers. Advice on the best buys and value for money are always offered to customers.

This company produces various hardware and software for the UK101, Video Genie, Superboard and TRS-80. Demonstrations of many of these and extras for the UK101 and TRS-80 will be on the stand. Special discount prices will be offered on several items.

CUA's latest booklets will be available to introduce users to machine code and also to outline many 'hidden' tips not mentioned in the manual. It will also be possible to join the UK101 users' group at the stand.

B47

Computing Today (Modmags Ltd),
145 Charing Cross Road, London
WC2H 0EE. Tel: 01-437 1002

Computing Today is among the country's leading personal computer journals and aims to help readers get the best out of their computer systems, however small or large.

Features are balanced between hardware and software; regular buyers' guides keep the reader in touch with the latest developments in the marketplace. Reviews of new computers and peripherals are frequently included, as well as constructional projects for the do-it-yourself enthusiast.

Readers are encouraged to submit programs to the magazine, the best of which will be published in the 'Softspot' feature.

B1

Contour Computer Services Ltd,
Boston House, 63-64 New Broad Street,
London EC2. Tel: 01-588 0041

Details not available by press date.

B44

Copyworld,
47 Brunswick Centre, London
WC1N 1AF. Tel: 01-837 3154

Details not available by press date.

T1, T2

Creative Computing,
Plot 23, Andrew Close, Stoke Golding,
Nuneaton CV13 6EL

Details not available by press date.

B41

Currah Computer Components Ltd,
Unit 7, Sandgate Industrial Estate,
Hartlepool Workshops, Hartlepool
TS25 1UB. Tel: 0429 72996

For under £200, the 220M digital recorder offers a faster, more efficient data storing alternative to disks and audio cassettes. There are no keys or controls as tape functions are initiated entirely by software, allowing greater flexibility to the user. Using this recorder enables an 8k Basic program to be loaded in about 12 seconds.

Typing SYS40400 and then 'RETURN' will find the first program on tape, load it and then run it automatically. This could be used as a 'Menu' allowing selection of other programs on tape. The 220M will be demonstrated on PET, Apple, AIM 65 and Acorn computers.

B4, B8

Data Applications (UK) Ltd,
16b Dyer Street, Cirencester,
Gloucestershire, GL4 2PF.
Tel: 0285 61828

The DAI personal computer, renowned for its excellent high resolution colour graphics using a domestic TV set, will be featured on the Data Applications stand along with the latest peripherals, including a new dual 5¼in floppy disk unit running the CP/M operating system. This unit will also support direct connection to a 5 Mbyte winchester disk drive.

Data Applications will show examples of computer-aided teaching programs running on the DAI which demonstrate the benefits of high resolution colour graphics and sound

facilities. All functions associated with graphics and sound can be controlled using the machine's resident Basic.

G25

Easicomp,
57 Parana Court, Sprowston, Norwich
NR7 8BH. Tel: 0603 416352

Details not available by press date.

T18

Elcomp Publishing Inc,
Box 750437, D-8000, Munich 75,
W. Germany.

Books and software for the Ohio Scientific computers and for the Atari 400 and 800 will be exhibited by Elcomp Publishing of California.

There will also be expansion boards for Apple II and ITT 2020, EPROM burners for Atari and machine code programming aids for the PET. Further information can be obtained from Elcomp at the above address.

B43

Electronic Aids (Tewkesbury),
Mythe Crest, The Mythe, Tewkesbury
GL20 6EB

Electronic Aids will be showing an audio cassette attachment for microcomputers and terminals. This winds, rewinds, locates a position on the tape, stops and plays, all under computer control, to provide good quality recorded sound. It is intended for educational and office use. Educational and accountancy software for engineering companies will also be shown.

G30

The Essential Software Co, Visconti Ltd,
47 Brunswick Centre, London WC1.
Tel: 01-837 3154

Details not available by press date.

B62

Feedback Instruments Ltd,
Park Road, Crowborough, East Sussex
TN6 2QR. Tel: 08926 3322

Feedback will display its new series of modules and interfaces for computer applications. These provide a link between the microcomputer and the outside world, a valuable extension to any system.

Technologists are now required to understand and use microcomputers to control and monitor other equipment. The skills needed can be taught through 'hands-on' experience using a microcomputer and Feedback's MIC940 interfaces, plus any of the range of eight MIC950 application modules.

B30

G W Design Services Ltd,
36a Hills Road, Cambridge CB2 1LA.
Tel: 0223 65832

Details not available by press date.

B24, B25

A J Harding (Molimerx) Ltd,
1 Buckhurst Road, Town Hall Square,
Bexhill-on-Sea, E Sussex
Tel: 0424 220391/223636

Molimerx Ltd is the sales division of A J Harding (Molimerx), well known to

readers for specialising in TRS-80 software ever since that machine's launch in 1978.

In co-operation with Lowe Electronics, importers of the Video Genie, Mr Harding and his staff now supply software for all three Genie models.

Software will be sold from the stand and many new packages will be introduced, including LDOS, which is available for the Genie I and II and the TRS-80 III.

B42

Humac Computer Services,
Regarth Chambers,
168-186 South Street, Romford, Essex.
Tel: Romford 752005

Details not available by press date.

B52

Ingersoll Electronics Ltd,
202 New North Road, London N1 7BL.
Tel: 01-226 1200

The Atari 400 and 800 personal computers will be the stars of the Ingersoll stand. Imported exclusively by Ingersoll, the Ataris have been designed specifically as easy-to-use home machines, aimed at users who, until now, never even dreamed of owning their own computer.

The Ataris plug into your own TV set to give spectacular full colour graphics and, being no larger than an electric typewriter, can even be taken to the office!

A4

Intex Datalog,
Eaglescliffe Industrial Estate,
Eaglescliffe, Stockton-on-Tees,
Cleveland TS16 0PN. Tel: 0642 781193

Intex Datalog will be showing PC-Basic, the true Basic compiler for the CBM. The compiler will take a Basic program from disk, change it into machine code and save it back onto disk as a loadable program file.

This versatile compiler can be a powerful debugging tool as well as compiling any program properly written in Basic. Such programs will then run up to 20 times faster than the original Basic.

Additional facilities include floating point and integer arithmetic, full syntax check and a security EPROM. Also available will be a selection of accessories, books, cassettes and disks.

T8, T9

IO Systems Ltd,
6 Laleham Avenue, London NW7 3HL.
Tel: 01-959 0106

Details not available by press date.

T19

Kansas City Systems,
Unit 3, Sutton Springs Wood,
Chesterfield S44 5XF.
Tel: 0246 850357

Kansas was launched at the second *Personal Computer World* Show at the West Centre Hotel. This year it will be launching the latest in the 'Arcade' series of fast action games for the TRS-80 and Video Genie. It hopes to have the series' creator, Mike Chalk, on the stand for part of the show.

Also featured will be the very latest

'Toolkit' program, which had such a good reception that Kansas has commissioned its writer, Len Weeks, to include even more functions and commands.

As in past years, Kansas will be making special offers for the show.

B58

Little Genius,
Suite 504, Albany House,
324 Regent Street, London W1R 5AA.
Tel: 01-580 6361

Three new product ranges as well as the existing teach-yourself-Basic course will be on the Little Genius stand. New games from Leisure Genius will be seen for the first time: 'Explosion', 'Death' and 'Worms'.

Business Genius will have plenty of new software on display, running on the TRS-80 as part of a company's training for junior and middle managers.

The third newcomer is a disk-based Teach-yourself-Pascal course in three modules — elementary, advanced and using Pascal practically and efficiently.

These new products will be run on the Apple, PET, TRS-80 and 380Z.

T16

London Computer Centre,
43 Grafton Way, London W1.
Tel: 01-388 5721

Details not available by press date.

G23

Lowe Electronics Ltd,
Bentley Bridge, Chesterfield Road,
Matlock, Derbyshire DE4 5LE.
Tel: Matlock 4495

The importer of the Video Genie, Lowe Electronics will have the new Genie II on show with additional keypad and many other improved features, together with a full range of system expansions and peripherals.

A1

L P Enterprises,
8-11 Cambridge House,
Cambridge Road, Barking, Essex
IG11 8NT. Tel: 01-591 6511

L P Enterprises (Microcomputer Products International Ltd) is a well-known company distributing software, books and magazines; many of these will be demonstrated, displayed and sold at the show.

Most software products will be demonstrated, with an emphasis on accounting and word processing packages, although some languages, utilities and games will be on show.

Subscription orders for magazines will be taken and a ten per cent discount offered on all software orders taken during the exhibition.

B28

Lucas Logic Ltd,
Welton Road, Wedgnoek, Warwick
CV34 5PZ

Lucas Logic Ltd, part of Lucas Industries Ltd, bought Nascom Microcomputers in May. Some of the benefit of this acquisition will be seen for the first time at the show.

The Nascom microcomputer has always been popular with the do-it-yourself enthusiast but now, to give it wider appeal, the Nascom II will be

available ready-built. The new case will be launched at the show. A further enhancement will be the twin floppy disk system, on show for the first time.

Additional boards will be displayed, such as the RAMboard with 16, 36 and 48k dynamic RAM and an extensive range of firmware will be available.

T20

Macronics,
26 Spiers Close, Knowle, Solihull
West Midlands B93 9ES.
Tel: Knowle 3693

Specialising in software for the ZX80, Macronics was the first to bring live action 'Breakout' and 'Space Intruders' to the ZX80 screen. Macronics' latest product, high resolution graphics for the 4k ROM, have been carried over to the ZX81 and the new ROM ZX80.

On show will be a ZX81 driving a plain paper full graphics printer and a disk operating system using a Shugart 5¼in disk drive without the need for an expensive disk controller. This considerably enhances the usefulness of the ZX81, particularly for the small businessman.

Macronics also intends to exhibit a high resolution graphics system for the ZX81.

G33

Maplin Electronic Supplies Ltd,
PO Box 3, Rayleigh, Essex.
Tel: 0702 554000

Maplin Electronic supplies will display the new range of Atari home computer systems along with the Workmaker speech synthesiser.

Atari systems offer the ability to display a multi-level screen in colour. This will be demonstrated by games and educational software. For music lovers, there will be a continuous demonstration of Atari's sound facilities and machines available for 'hands-on' use.

Two new products for the Atari will be launched and software will be on sale.

G32

March Communications,
7 Victoria Terrace, Liverpool L15 5BH.
Tel: 051-227 5100

March Communications will have something for everyone. For Apple users there will be the new range of expansion cards by March and hot off the press, the latest issue of *Windfall* magazine, plus back numbers.

For the DIY enthusiast, the well-established range of computer boards from Kemitron will be displayed.

The new range of British games, business software from Mythmaker and Vertex will be unveiled at the show. March will also have a large stock of computer books available and the second edition of its 'Computer Booklist' will be given free to visitors.

A17

MC Computers Ltd,
Park Street, Newbury, Berkshire.
Tel: 01-668 4151 ext 404

MC Computers will demonstrate a range of industrial interfaces to suit most microcomputers. These will include the universal Plant Interface Peripheral (PIP), plug-in I/O cards for Apple II, an

IEEE-488 compatible analogue output unit, also suitable for PETs, and a new IEEE to serial (RS232) converter.

A number of accessory items such as marshalling panels for signal termination and new option cards for the PIP will also be on show.

T12, T13

Microcomputer Printout,
PO Box 48, Newbury RG16 0BD.

A plain man's guide to personal computing. *Printout* is aimed at the beginner and written in plain English, without any confusing jargon. It conducts consumer tests on programs and peripherals for popular microcomputers like the PET and VIC.

For the PCW show, *Printout* is publishing a special report on computers for beginners which will concentrate on the British, American and Japanese machines about to flood high street stores for the Christmas season. A copy of this report will be available at the show.

A8

Micro Value,
4 Westgate, Wetherby, W. Yorks.
Tel: 0937 63774

Details not available by press date.

B66

Mind Your Own Business,
106 Church Road, London SE19 2VB.
Tel: 01-771 3614

Mind Your Own Business is a monthly magazine for managers of multinationals, public and private companies and small businesses. The magazine aims to help managers and directors learn about new business methods, office equipment and office automation.

Editorial consideration is mainly given to word processing, small business systems, communications and data processing. Copies of the magazine will be given free to visitors at the stand.

G2

Mine of Information Ltd,
1 Francis Avenue, St Albans AL3 6BL.
Tel: 0727 52801

MOI was established in 1977 as a consultancy, publisher and bookseller specialising in microcomputers. Today, MOI is Britain's leading independent microcomputer bookseller.

The emphasis is on quality. MOI will be showing and selling the current selection of first class microcomputer books from many different publishers.

A11, A13

NEC Telecommunications Ltd,
NEC House, 164-166 Drummond Street,
London NW1 3HP. Tel: 01-388 6100

NEC will be showing its PC-8000 desktop microcomputer, the fastest-selling micro in Japan. The PC-8000 interfaces to a VDU (mono or colour) and cassette recorder and can be expanded to handle floppy disks and RS232-type peripherals. The machine comes with Basic in 24k of ROM and with 32k RAM, expandable to 64k, allowing the use of CP/M.

Also on show will be the new 7700 series Spinwriter, an advanced version of the 5500 series, and the low-cost 2500 series.

A12

Newbear Computing Store,
40 Bartholomew Street, Newbury,
Berks. Tel: 0635 30505

Details not available by press date.

B64

Oxford Computing Ltd,
48 Crown Street, Reading, Berks.
Tel: 0734 587138

Details not available by press date.

B34, G27

Personal Computers Ltd,
194-200 Bishopsgate, London
EC2M 4NR. Tel: 01-624 7174

Details not available by press date.

A23

Portatel Conversions Ltd,
25 Sunbury Cross Centre,
Sunbury-on-Thames, Middx.
Tel: 76 88972

Based on Sweden's Luxor range of colour televisions, the Portatel Luxor colour monitor provides a colour display from a EurApple microcomputer without the need for a 'Colour Card'. High resolution colours are produced on a precision in-line graphics quality tube. It accepts direct input from the computer without modification, adjustment or a modulator. Text only display is improved by an automatic colour killer. An underscan switch for 80 column use is included. The text window is 50 per cent larger than normal TV screens, which is useful. White or green text to order.

T10

Radio Shack Ltd,
188 Broadhurst Gardens, London
NW6 3AY. Tel: 01-624 7174

Details not available by press date.

B46

Research Machines Ltd,
PO Box 75, Mill Street, Oxford.
Tel: 0865 49791

Research Machines is showing the new 480Z microcomputer and Varitext, a major enhancement to the well-established 380Z range.

The 380Z is a high performance (32k minimum) cassette system based on the Z80A. It incorporates many useful features such as a dual cassette controller, video and UHF outputs, analogue output and tone generation.

Varitext not only lets the user choose the line length/character size most appropriate to his application but also introduces several screen handling facilities, for example: 'windowing', selective dimming, character high-lighting, fast screen filling and many others.

B36

Roxburgh Printers Ltd,
22 Winchelsea Road, Rye, E Sussex.
TN31 7BR

Roxburgh will exhibit a large selection of printers, notably the latest Star 80 column bidirectional printer and the popular X80-SP intelligent printer/plotter, for which a wide range of inter-

face options can be offered.

Magnetic storage devices such as a miniature DC-100 cartridge drive and a 2½in micro floppy disk recorder will be on show, along with a large family of printer mechanisms including thermal, impact needle and impact drum types. An extended range of interface cards is now available to drive the Star 21 and 40 column mechanisms.

T21

SBD Software,
15 Jocelyn Road, Richmond TW9 2TJ
Tel: 01-948 0461

SBD Software specialises in software for the Apple II. One of its wide range of packages is the 'Magic Window' word processing package, for which SBD is the sole UK distributor.

This is a 40-column package but by using horizontal scrolling you can see all 80 columns. It is compatible with the Dan-Paymar lower case adaptor so you can see both upper and lower cases on the screen. This package and all its features will be on display at the stand.

There will also be a wide range of utilities such as copy programs and copy recovery and all the latest Apple programs.

G18

Silica Shop Ltd,
1-4 The Mews, Hatherley Road, Sidcup, Kent. Tel: 01-301 1111

Silica Shop will exhibit not only the latest in Teletext/Prestel decoders but also a selection of new low-cost printers and a USA field-trial sample of the Intellivision Keyboard (an addition to the 16-bit Mattel TV game), to be launched in Spring 1982.

The Atari XK2600 will be on show, complete with 'Le Stick', a new single-handed joystick attachment. Several new chess computers from Silica Shop's range, along with some interesting and original software and details of a UK Silica-Atari 400/800 users' group will also be available on this stand.

G22

Sinclair Research Ltd,
6 Kings Parade, Cambridge CB2 1SN.
Tel: 0276 66104

Details not available by press date.

T11

Southern Software,
PO Box 39, Eastleigh, Hants SO5 5WQ.
Tel: 04215 67274

On display will be some of Southern Software's range of systems programs for the TRS-80 Model I, now adapted to run on the TRS-80 Model III and Video Genie.

All users of Basic on these machines can benefit from improvements in execution speed obtained by compiling Basic programs using Southern Software's accelerators, ACCEL and ACCEL-2 which translate Basic into machine code. 'Before' and 'after' demonstrations at the show will illustrate speed gains of 20 or 30 times for sample Basic programs.

Also on show will be a full screen editor and a command-list interpreter for automating often-repeated sequences of TRSDOS commands.

B21

ST Commercial Systems,
24 Ranelagh Street, London W5.
Tel: 01-840 1926

Details not available by press date.

T14, T15

Supersoft,
1st Floor, 10-14 Canning Road,
Wealdstone, Harrow, Middx.
Tel: 01-861 1166

Supersoft offers a large range of software and accessories for Commodore computers. The emphasis is on programming aids and utilities, especially chip-based products like Superchip and Micro Assembler. In its catalogue, you will also find word processing, business packages, educational programs and games.

The recently launched HI-RES graphics board costs less than £150 but offers 64,000 individually addressable points in a 300 by 200 matrix. Utility software is provided in EPROM and additional packages are available.

B17, B20, B31, B16

Tandy Corporation,
Tameway Tower, Bridge Street, Walsall, West Midlands WS1 1LA.
Tel: 0922 648181

Tandy Corporation will be exhibiting the three TRS-80 models and the pocket computer, which will be used to demonstrate a number of novel applications for this kind of product.

The TRS-80 Model III will be demonstrated formally and will be available for 'hands-on' use by visitors. The latest software will be shown, including Visicalc, Scripsit (word processing) and a wide range of software designed or both school and industrial use.

Printers and other peripherals for the TRS-80 will be on the Tandy stand. Some of these will be on display for the first time.

A21

Tangerine Computer Systems,
Forehill Works, Forehill, Ely, Cambs
CB7 4AE. Tel: 0353 3633

Tangerine is well known for the Tantel viewdata adaptors, which produce a high quality display and can be used on black and white or colour televisions. The units are very compact and contain the latest computer technology. The Alphanumeric is particularly suitable for private systems.

Tangerine will also exhibit modules from the successful Microtan 65 system, including TANRAM, a 40k add-on memory board, the new high resolution graphics board and various serial and parallel interface cards.

G4

Ties Investments Ltd,
18 Connaught Square, London W2 2HJ.
Tel: 01-262 6956

Details not available by press date.

G28

Timedata Ltd,
57 Swallowdale, Basildon, Essex.
Tel: 0268 23234

Details not available by press date.

B14

Transam Computers Ltd,
59-61 Theobalds Road, London WC1.
Tel: 01-405 5240

Details not available by press date.

B3, B5

The Vero Group of Companies,
School Close, School Lane, Chandlers
Ford Industrial Estate, Eastleigh,
Hampshire SO5 3ZR.
Tel: 042 15 66300

From Vero's retail department, examples of hobbyist-orientated products will be on sale, including Veroboard, DIP board and a range of plastic boxes.

The three manufacturing divisions of the company will have the Apple Breadboard available, along with a good many other microprocessor compatible prototyping boards and backplanes for the S100, Motorola Exorciser and Intel Multibus.

In addition to this, a VDU case in structural foam and a 19in desk unit in mild steel will be shown by the enclosure division. Verospeed, Vero's distribution company, will have selected products on show, with a catalogue available on request.

G10

The VIC Centre,
154 Victoria Road, Acton, London W3.
Tel: 01-579 1962

The first computer store in the UK dedicated to the Commodore VIC-20, the VIC Centre aims to offer the most comprehensive range of VIC hardware, software and relevant supplies. The centre is backed by the resources of Adda computers, one of Commodore UK's leading dealers.

All goods available at the VIC Centre (next to North Acton tube station) will also be obtainable by mail order. The Centre runs a free users' group and it will be possible to join at the show, as well as to buy a VIC-20. Books and software will be available.

B72

VNU Business Publications BV,
53-55 Frith Street, London W1.
Tel: 01-439 4247

Details not available by press date.

B32

John Wiley and Sons Ltd,
Baffins Lane, Chichester, W Sussex
PO19 1UD. Tel: 0243 784531

John Wiley and Sons will exhibit not only its own computer books but also a selection published by the Hayden Book Co Inc and the Sigma Technical Press. A wide range of Hayden software will be on display as well. This includes the Applesoft compiler which translates Basic into machine code.

Among new and recent books on show will be titles specifically for the Apple, TRS-80 and Atari machines alongside books dealing with all aspects of programming languages and applications.

John Wiley is at present developing its own range of software for all applications and would welcome details of suitable projects from visitors.

LOCAL DEALERS

LONDON

Bellmartin Services Limited
194 Union Street
London SE1 0LH
Tel: 01-928 5322/3

Lion House (Retail) Limited
227 Tottenham Court Road
London W1P 0HX
Tel: 01-637 1601

Personal Computers Limited
194-200 Bishopsgate
London EC2M 4NR
Tel: 01-626 8121

S. W. Winter & Co. Limited
101 Westminster Bridge Road
London SE1 7HR
Tel: 01-633 9611

PROVINCES

Avon

Microstyle
29 Belvedere
Lansdown Road
Bath BA1 5HR
Tel: 0225 334659

Buckinghamshire

Chiltern Microcomputers Limited
7 Amersham Hill
High Wycombe HP13 6NQ
Tel: 0494 20416

Cleveland

Weyfringe Limited
Longbeck Road
Marske
Redcar TS11 6HQ
Tel: 0642 470121/2/3/4

Corwall

Diskwise Limited
25 Fore Street
Callington PL17 7AD
Tel: 05793 3780

Hertfordshire

CCS Microsales
7 The Arcade
Letchworth SG6 3ET
Tel: 04626 73301

Merseyside

Currie (Business Equipment)
Limited
8 Upton Road
Claughton
Birkenhead L41 0DF
Tel: 051 658 5111

Business Equipment Centre
(Liverpool) Limited
31/35 Edge Lane
Liverpool L7 2PA
Tel: 051-263 5783/4421/
5738/6683

Norfolk

Anglia Computer Centre
88 St. Benedicts Street
Norwich NR2 4AB
Tel: 0603 29652

Oxfordshire

Alphascan Limited
Little Bourton House
Southam Road
Banbury OX16 7SR
Tel: 029 575 8202

Surrey

T & V Johnson Limited
(Microcomputers Etc.)
Johnson House
75-79 Park Street
Camberley GU15 3XE
Tel: 0276 20446

Warwickshire

Business and Leisure Micro
Computers
16 The Square
Kenilworth CV8 1EB
Tel: 0926 512127

Gallid Limited

1 Bilton Road
Rugby CV22 7AA
Tel: 0788 74442/3

West Midlands

Camden Electronics Limited
462 Coventry Road
Small Heath
Birmingham B10 0UG
Tel: 021 773 8240

C.P.S. (Data Systems) Limited

Arden House
1102 Warwick Road
Acocks Green
Birmingham B27 6BH
Tel: 021 707 3866

Worcestershire

Arrow Business Computers
Limited
Royal House
11 Market Place
Redditch B98 8AA
Tel: 0527 62733

SCOTLAND

Strathclyde

Turnkey Computer Technology
Limited
23 Calderglen Road
St. Leonards
East Kilbride G74 2LQ
Tel: 03552 39466

Video Vector Dynamics Limited
39 Hope Street
Glasgow G2 6AE
Tel: 041 226 3481/2

WALES

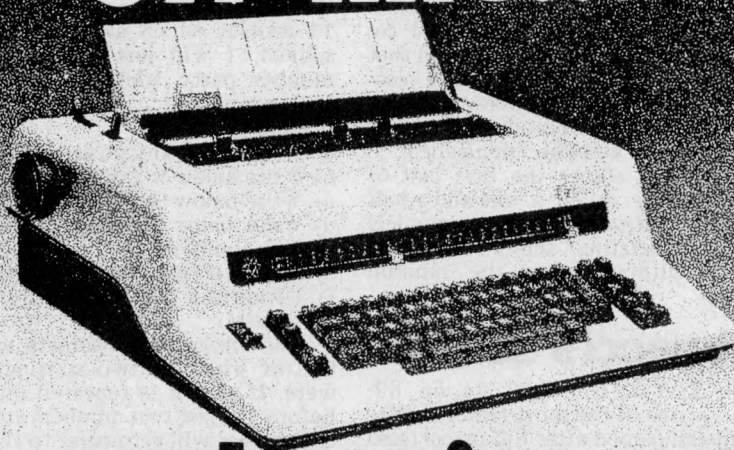
South Glamorgan

David Potter Office Equipment
Limited
164 Richmond Road
Cardiff CF2 3BX
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516 Mumbles Road
Mumbles
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PATTERNS

Alan Sutcliffe ponders the Fibonacci series and a do-it-yourself clock.

I recently read about a program I had written years ago, not realising that it was my own work being referred to. Once the penny dropped, I recalled that this program helps to improve the resolution of timing that is possible on some systems; I therefore reproduce it here as more than mere nostalgic indulgence.

Before that comes the first half of what might be called a one-and-a-half part serial, introducing an economical way of generating series of whole numbers without using the random function.

Fibonacci's series

0, 1, 1, 2, 3, 5, 8, 13, 21, 34, 55, 89, 144 ... is one of the most famous series of numbers, named after Fibonacci (also called Leonardo of Pisa, as distinct from the other one). The series was known much earlier, probably to the later Greek mathematicians. Each term is the sum of the two preceding terms, and the first two terms are taken as 0 and 1. The formal definition is: $F_0 = 0$, $F_1 = 1$, $F_{n+1} = F_n + F_{n-1}$ for $n > 0$.

Fibonacci was born in Pisa in 1175 and lived there or thereabouts until 1230. One historian describes his work as the only event of mathematical importance in Europe during the thousand years up to about 1450. His most significant contributions were both importations from the East. He is credited with the introduction of the decimal notation from India, replacing the hopelessly awkward Roman numerals by Arabic ones — a great leap forward in notation which might be compared to the development of programming language in our own time. His second oriental novelty was to introduce the algebra of Al Khoresmi, the Persian who also gave his name to the algorithm. The introduction of algebra can be compared with the development of electronic computers in its effect on our ability to solve problems.

Fibonacci himself was so adept at solving problems using the new algebra that in 1225 the Emperor Frederick II went to Pisa to hold a mathematical tournament, with Fibonacci as the star of the show. However, the great man was not right in everything, for he thought that $\pi = 864/275 = 3.1418...$

The Fibonacci numbers are an unending resource, an inexhaustible mine of mathematical patterns and relationships. In 1966 the Fibonacci Association was formed in the USA which publishes the *Fibonacci Quarterly*, devoted to the study of these numbers and similar series of integers.

I am resisting the temptation to give a few of the better known properties of the Fibonacci numbers, as these can be found in almost any book on recreational mathematics or elementary

number theory. The *Fibonacci Quarterly* has just completed a series of 14 articles which are a primer on the subject. I will just give a think-of-a-number party trick based on one of their properties. As far as I remember, I invented this:

- Write down any positive number;
- Write below it any positive number;
- Write below this their sum;
- Write below this the sum of the last two numbers;
- Repeat step d three further times;
- Divide the last number by the next to last.

The answer is 1.6-something, regardless of what the two starting numbers were. If step d is repeated more times before the last two numbers are divided, the answer will get nearer to the Golden Mean, $(\sqrt{5} + 1)/2 = 1.6180...$

The Fibonacci series is a fascinating pattern in itself, which also occurs in one of nature's most attractive patterns, the arrangement of seeds in a sunflower head. In a well-formed flower, the seeds spiral in both clockwise and anticlockwise lines. The numbers of lines in the two directions should be consecutive numbers in the series.

The numbers can also be used to generate less regular patterns of numbers. Suppose that a series of integers is wanted in the range 0 to 9. The usual way to do this would be to use the random function:

$N = \text{INT}(\text{RND}(0) * 10)$

This is compact but involves two function calls and a multiplication: RND itself will contain at least a multiplication and a division.

Instead, consider the code in Program A. This gives the last digit of the Fibonacci numbers in decimal. The first 75 values are printed after the program.

On my DAI computer, this routine takes just over half the time to obey of the one-line call to RND. My system has the hardware maths option which speeds up floating point arithmetic greatly; without it, time saving would be more like ten or 20 times. Looking at the results, however, you will see that the disadvantage of the routine is that the values repeat in a cycle only 60 items in length. Every algorithm on a finite computer must cycle eventually but the period of repetition for the RND function should be many millions.

Now, it may just be that a short repeat is what is wanted — in wallpaper design, perhaps. But usually a cycle of only 60 will be too short. Ways of extending the length will be described in the next article. First, I want to go into finding out how long the cycle is in a particular case without printing out all the values and looking for the repeat. Look at the results from Program A. You can see that the pattern of repeats falls into two separate cycles: there is a zero value every 15th item, and after four of these groups of 15, the sequence 0, 1, 1 ... starts again. The numbers in each group follow their sequence by addition — from the defining rule for the Fibonacci series. But the sequence of the numbers immediately following each zero follow by multiplication. The first two such values are 1 and 7, so on each succeeding step there is a multiplication by 7; 7x7 gives 9, remembering that only the last digit of the result is being kept, then 9x7 gives 3, and 3x7 gives 1 again, completing the cycle.

This gives a short cut in computing the whole cycle length. The main steps in the process are: count the F numbers until the next zero is found; take the value of the next F number, say N; compute the powers of N until the result is 1; multiply the lengths of these two cycles to give the total cycle length. All this is (MOD 10), that is taking only the last decimal digit from each sum.

The code to do this is given as Program B. Economical as ever, I have multiplied the cycle lengths together by repeated addition; this saves incrementing a separate counter for the second cycle. I have used the MOD function, too, since this is available on my DAI machine. In more standard Basic this can be done by defining a user func-

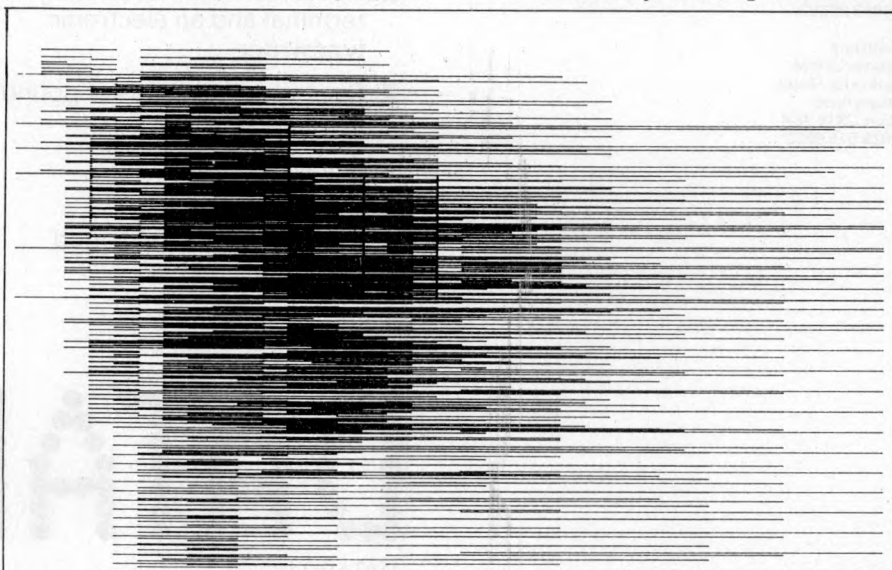


Fig 1 Fibonacci fancy

tion that calculates the remainder of one number on division by another.

G H Hardy was one of the foremost pure mathematicians this country has produced in the 20th century. He was also an attractive writer and in *A Mathematician's Apology* he says that journalism is the only other profession in which he felt confident that he could have succeeded. But I mention Hardy to give a quotation which could well be a banner for this column: 'A mathematician, like a painter or a poet, is a maker of patterns.'

So here, in Figure 1, is a pattern based on the Fibonacci digits. Next month I will show how this method can be developed, without too much more computation, to generate sequences of much greater length, as well as giving some more examples of their use. As an interlude I turn to a more practical program, where the pattern is simply in the programming idea it embodies.

The Sutcliffe clock

Many computer systems are equipped only with a comparatively coarse clock, one that measures only seconds or large fractions of a second. There is often the need to measure the passage of time much more accurately than this, particularly in running benchmarks and other measures of performance.

The Sutcliffe Clock is a sleight of programming that allows fine measurements of time on a system which only has a coarse clock. But before I describe it in detail, a few words about how I came to develop it.

In 1966 I joined ICT, as it then was, at Brandon House, Bracknell, and the first job I was given was to carry out some performance measurements on 1900 computers.

There was at that time a performance measure in wide use called the Post Office Work Unit (POWU). This was a mix consisting of 21 elementary computational and input/output tasks, together with a weighting for each one. The tasks were such things as: shift the contents of a register three bits to the right ignoring any lost bits; write a block of data from store to magnetic tape. The weightings were based on an analysis of programs being run by the Post Office in the early 1960s. Multiplying the time for each task by its weight and adding all the results together gives a total POWU time for that system.

Until our project, the POWU timing had only been done for 1900 computers (and as far as I know for other systems, too) on paper. That is, by using the information in the hardware timing manual to calculate the likely time taken by each task.

What we wanted to do was measure the POWU tasks running on real 1900 computers. However, the only clock on these machines that is accessible to user programs is one that gives the time of day correct to the nearest second. There is an assembler language instruction which loads the time into a register where it can be inspected.

Each POWU item takes a time in the range from many microseconds to a few milliseconds. The first obvious trick to get measurable times is to obey each

100	DIM F(2)	For the last two F numbers
110	F(0)=0	Set the
120	F(1)=1	initial values
130	I=0	Subscript: 0 or 1
200	GOSUB 800	Compute the next F number
210	PRINT G	and print it
800	G=F(0)+F(1)	Sum of last two
810	IF G < 10 THEN 830	If G is greater than 9
820	G=G-10	subtract 10
830	F(I)=G	Replace older number
840	I=I+1	Switch subscript
850	RETURN	

```

0 1 1 2 3 5 8 3 1 4 5 9 4 3 7
0 7 7 4 1 5 6 1 7 8 5 3 8 1 9
0 9 9 8 7 5 2 7 9 6 5 1 6 7 3
0 3 3 6 9 5 4 9 3 2 5 7 2 9 1
0 1 1 2 .....

```

Program A and the Fibonacci number (MOD 10)

200	N=1	Initialise first cycle length
210	GOSUB 800	Get next F number
220	N=N+1	Increment cycle length
230	IF G > 0 THEN 210	Look for next zero
240	GOSUB 800	Next F number after zero
250	C=0	Initialise second cycle count
260	M=1	Initialise power
270	M=M*G MOD 10	Next power
280	C=C+N	Add first cycle length
290	IF M < 1 THEN 270	Complete if M=1
300	PRINT C	

Program B

task in a loop a large number of times, say 1000. This brings the time needed up to something of the order of one second. Remembering that each task must be timed separately, because it has to be multiplied by its individual weighting, this alone would give very inaccurate results. Increasing the number of repetitions to, say, a million would mean using far too much computer time — around 1000 or more seconds for each task. This was particularly unacceptable on 1900 computers running under multi-programming, since we had to have sole use of the hardware to get the timings.

As well as obeying a loop containing the task, another loop must be timed which just contains the control part of the loop, so that this time can be subtracted from the time for the loop content plus loop control, to give the net time for the work item. This, then, is the basic structure of the timing program for each POWU item.

- 1) Get time, A;
- 2) Obey loop with POWU item 1000 times;
- 3) Get time, B;
- 4) Get time, C;
- 5) Obey empty loop 1000 times;
- 6) Get time, D;
- 7) Compute time for item: (B-A-(D-C))*WEIGHT/1000.

But this is not accurate enough — in fact, as it stands, it is useless. What has to be done is to get much more exact estimates of the times. The values of A and C the start for each loop, accurately set by lining them up with the start of a second; this is easily done by idling in a loop until the clock time changes and then starting the timing. The remaining problem is to get better estimates for B and D, which may come

anywhere in the middle of a second.

The only slightly clever part of my method was to use as the unit of time, one tick, the time taken to inspect the clock once, to add 1 to a counter, and to test whether the clock has changed. This unit is itself calculated at the start of the program by running a loop from one clock change to the next and counting the number of times round the loop to give TPS, ticks per second. The value of TPS ranged from several hundred to a few thousand on different 1900 computers. This value also represents the increase in accuracy of the time measurement over simply using the nearest second.

To get a better estimate of the time B using ticks, all that is needed is to measure the time from B to the next clock change — the unused part of the last second. Immediately the main loop is ended, a loop counting ticks must be entered, so that the steps 1 to 3 above are expanded into:

Get time	
Has time changed	N
New time, A	Y
Obey loop 1000 times	
Get time, B	
Get time	N
Increment counter	
Has time changed	Y
Carry on	

This is shown graphically in Figure 2, where J is the number of ticks in the unused part of second B. It is the used part of this last second that we want, so the expression B - A in step 7 above has to be replaced by B - A + TPS - J.

TPS

The same method is used to estimate the time D accurately. The code for the whole process is given in Program C. In this the time is read by a call to a

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function CLOCK, with an unused parameter. In my original program to compute the POWU, this process was repeated for each of the 21 tasks and the final value obtained as the sum of the parts.

On today's small systems the same method can be used to get timings for individual statements in Basic, for example — provided always that there is at least a coarse clock to start with.

Back in 1966 I wrote an internal ICT report on the method and results. The results were confidential and it did not occur to me that the method was important enough for publication outside the company. But I did mention it to Brian Wichmann of the National Physical Laboratory and he referred to it in a paper.

My boss seemed pleased, if not impressed, by my POWU program and when he was promoted soon afterwards I got his job, manager of New Series Branch, in strict accordance with Parkinson's Law. But that's another history.

Move on 14 years to 1980, when I was working on a study of methods for evaluating database systems, long after leaving ICT. I was reading a report by David Deutch of the National Bureau of Standards on this subject when I came to a reference to the Sutcliffe Clock. Funny coincidence, I thought, who is this namesake of mine who has done something quite like my program of all those years ago? Only days later did I realise that it was me. Fame at last — a named effect. Well, better to have it for something simple than not at all.

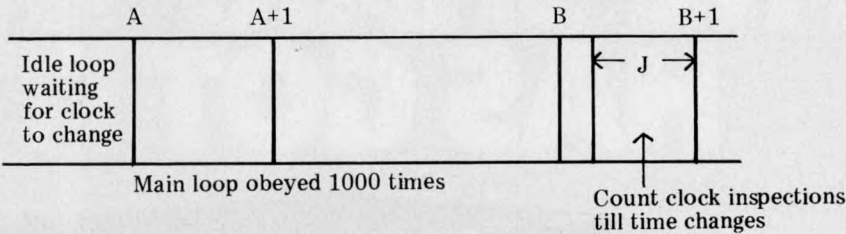


Fig 2 Main timing loop.

100	TPS=0	Ticks per second	Program C
110	J=0	Counter for main loop	
120	K=0	Counter for control loop	
130	A=CLOCK (0)	Get time	
140	B=CLOCK (0)	Idle loop waiting for clock to change	
150	IF A=B THEN 140	Jump back if same time	
160	A=CLOCK (0)	Loop to give ticks per second	
170	TPS=TPS+1	increment counter	
180	IF A=B THEN 160	Jump back if same time	
190	FOR I=1 TO 1000	Main loop including	
200	Z=SQR(0.1)	statement to be timed	
210	NEXT I		
220	B=CLOCK (0)	Get time	
230	C=CLOCK (0)	Loop to count ticks	
240	J=J+1	in rest of second	
250	IF B=C THEN 230	Jump back if same time	
260	FOR I=1 TO 1000	Loop to time	
270	NEXT I	control statement only	
280	D=CLOCK (0)	Get time	
290	E=CLOCK (0)	Loop to count ticks	
300	K=K+1	in rest of second	
310	IF D=E THEN 290		
320	TIME = (B-A+(TPS-J)/TPS-(D-C+(TPS-K)/TPS))*WEIGHT/1000		

At the end of the loop to calculate TPS, A is automatically lined up at the start of a second and similarly for C after timing the main loop. The final expression for TIME can be simplified to: $320 \text{ TIME} = (B-A - D + C + (K-J)/\text{TPS}) * \text{WEIGHT}/1000$ but its derivation is less than clear.

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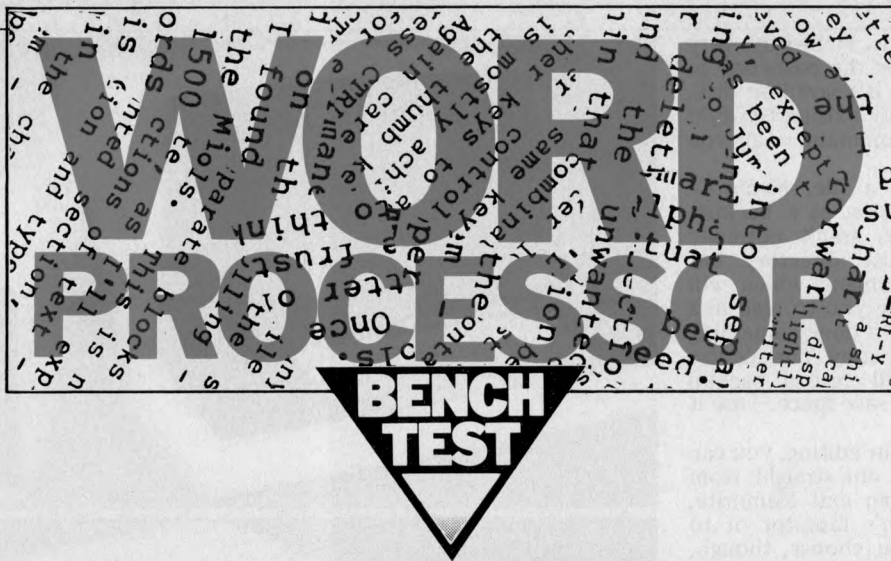
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MEMORITE III

This month Peter Rodwell gets his hands on the latest Vector Graphic, complete with VG's own WP package.

Vector Graphics is an American micro-computer manufacturer which makes no secret of the fact that it's interested only in selling business machines. In the States, in fact, it doesn't even advertise in the computer press, preferring to concentrate on the sort of publications that businessmen read.

The current range of Vector Graphics machines starts with the single-disk VIP (which we Benchtested in February this year), continues through the twin-disk System B and 2800 systems and peaks with the recently-launched 3005, which has one minifloppy disk and one 5 Mbyte winchester hard disk.

Vector Graphics markets a number of packages, including a Visicalc-like planner called Execuplan and a word processor called Memorite III, the subject of this test.

Memorite III will run on all the Vector Graphics machines but I couldn't resist the offer of the top-of-the-range 3005 as the hardware to test Memorite; I'll talk about the hardware in more detail later.

Editing

Memorite III is a combined editing and formatting program which, although it runs under CP/M, has been designed specifically for Vector Graphics machines ('six man-years to develop,' says Vector).

With Memorite loaded, you're left with a text buffer of 30,170 characters, approximately equivalent to nine and a half single-spaced A4 pages.

The editor provides a good range of facilities and, although there are plenty of commands to remember, they are all simple and most are sufficiently logical that they very quickly become second nature to use.

As with most of the better word processors, Memorite gives word wrap-around, enabling you to dispense with pressing return at the end of each line, which speeds up text entry enormously. Four cursor movement keys are provided and the up/down keys, when shifted, provide backwards/forwards scrolling;

this last feature can be changed to display screenfuls at a time rather than continuous scrolling. Keeping the keys depressed while scrolling progressively slows the scrolling speed, right down to almost one line per second. You can also jump directly to the beginning or end of a screen or of the whole text. One nice feature is that, before scrolling or jumping around, you can save the cursor position and return to it immediately afterwards simply by pressing the escape key.

Inserting text is done either on a character-by-character basis or by opening a line on the screen, which, if not completely filled, will be closed up again when you exit this mode. Deletion works on single characters or from the cursor position to the first occurrence of any specified character; this allows you to specify a space for word deletion, a '.' for sentence deletion or even a return for paragraph deletion.

All the commands I have mentioned so far operate directly from the editing mode, mostly by pressing easy-to-remember control commands. Other facilities are available by exiting the editing mode to get into the command mode — these include all disk handling, search and replace, block moves and others.

In the command mode, the bottom three lines of the display are taken over with a two-line reversed video status display and a blank line beneath on which you type your commands (see photo). The status line shows the name and author of the document currently being edited, its length (in characters) and the number of unused characters remaining in the buffer, the type of printer for which the system is set up and the disk drives in use.

Block move is disguised as a copy command. This allows you to copy blocks of text from one part of the buffer to another but, as it gives you the option of retaining or deleting the original block, it also functions as a block move facility.

Search and replace ('find item' in Memorite parlance) is straightforward

and allows you to operate backwards or forwards from the cursor position and has a query option, which allows you to leave some occurrences of the string being replaced as they are if you want to.

Tab stops can be set at every *n* characters or only in specific places; a tab ruler can be displayed to show you exactly where the tabs have been set and the tabs are saved with each document on disk, which makes life much easier if you use different tab layouts for every document.

The disk handling is simple and very well thought out; once into Memorite, the user is totally insulated from the unfriendliness of CP/M, which is good, and the system is simple to use and totally idiotproof.

Test files are saved by first giving them an 'identity'; this comprises a file name, of course, but also includes the author's name, a password and up to 25 characters of comment — the last two are optional. When you give the actual write to disk command, you are asked to type in the date in the American MM/DD/YY format (not DD/MM/YY as it says in the manual); I found this extremely annoying as it's not a piece of information which I need to store with every document yet with Memorite it's compulsory, even when saving a revised version of a document already on disk.

Reading a file is very easy. Asking for the disk directory gives a display of all the identity information for each file as well as the number of revisions for each file and their dates: the date each document was created and the date it was last revised. The directory can be printed out if required.

To read in a file, you move the cursor to its entry in the directory, type 'R' and in comes the text, unless, that is, you've given it a password, in which case you're asked for the password and you can only obtain the text if you reply with the correct one; the password does not appear on the screen, either when giving the document its identity or when trying to retrieve text. The

password protection is, incidentally, very secure; Memorite uses the password to scramble the text as it's saved on disk, so you can't read it by exiting to CP/M and giving a 'type' command — all you get is garbage.

When you revise a file, Memorite saves the earlier version as a backup. These backup copies aren't normally displayed on the disk directory but there's a special command which will display them, allowing you to read in a backup copy if you've done something awful to the working copy. There's also a command which will erase all backup copies from a disk to save space — use it with care.

Having finished your editing, you can either print the text out straight from the buffer or you can exit Memorite, either to the system's monitor or to CP/M. Whichever you choose, though, Memorite won't let you go until you've saved the text in the buffer onto disk, an excellent safeguard which can only be overcome by erasing the text first, pressing the reset button at the back of the machine or turning the machine off altogether.

Spelling

It's quite embarrassing to have typed in your text, formatted it and printed it out, only to discover some silly spelling mistakes (or have someone else discover them). It means you've got to re-edit and reprint, wasting time and paper. Memorite can help you avoid this because it comes with a spelling correction program.

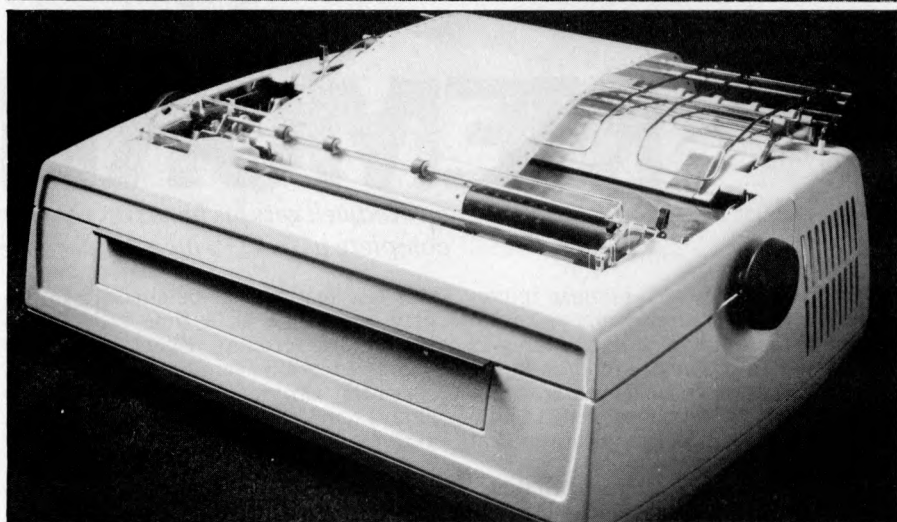
SPELL comes as a separate program, incorporating a 30,000-word dictionary, which you run after you've saved your file on disk. The text is displayed line by line on the screen and any words which the dictionary doesn't recognise are highlighted in flashing reverse video. The program waits for you to either type in the correct spelling (but it doesn't tell you what that is!) or you can just press return, which causes SPELL to include the word in a 255-word temporary dictionary so it won't query further occurrences of the same word in that text.

Although 30,000 words sounds a lot, I found that SPELL queried a lot of words which I'd regard as fairly ordinary — 'microcomputer', 'camera' and 'eleventh', for example (also 'Memorite'). SPELL is also an American product, which means it will query things like 'colour' and 'recognise', which is mildly irritating — why doesn't someone come up with English versions of these spelling programs?

If you're a rotten speller, SPELL will be worth its weight in gold; for the rest of us it's also very handy for weeding out typing mistakes, which it does far more quickly than a human proof-reader could do (*nonsense!* — *Irate Sub Editor*), making it much more than just a gimmick.

Printing

Memorite III has a powerful range of print formatting commands, fewer than Spellbinder or Magic Wand but enough for most general users. They're also fairly easy to use and the system has a sensible set of default parameters for formatting (ie, if you don't specify things like left and right margins, the



Above: The VG3005 and its disk unit; below: the NEC Spinwriter 7700.

system will use its own, pre-set, values which will give a reasonable-looking result).

If you don't like some of the default settings, you can create your own and incorporate them into the program on disk so that they will always be present when you run Memorite. The formatting commands are partly these semi-permanent parameters and partly commands embedded within the text. The pre-set commands can, however, be over-ridden by inserting different settings for them in text or by typing new ones in from the keyboard before printing.

All the usual formatting features are present: left, right, top and bottom margins, justification on or off, centred lines, etc. The system provides control over ghost hyphens and forced spaces, page breaks, indentation, character and line spacing, page width and length, and page numbers — you can start a document with page numbering from any figure, not just from 1.

Printer control is good, but is geared totally to daisywheel printers — as far as I could establish, it's not possible to use a cheap dot matrix printer with Memorite III, which is a pity because dot matrix units, being much quicker, are handy if you want to run off several draft copies of a document for circulation to a number of people.

Memorite allows underlining, bolding, overstriking, extra strike, super- and subscripts, and contains the ability to cope with proportional spacing, found on the really top-quality printers. Printing can start at any page in the document and can be stopped at any

time. There's provision for stopping the printer after any page, which is necessary for printing on single sheets instead of continuous stationery.

There is, unfortunately, only the most rudimentary facility for previewing formatted text on the screen before you print it. This allows you to see just the page breaks, enabling you to spot awkward layouts such as a page ending with, say, a chapter heading on its last line.

You can print directly from the keyboard, making the system an extremely expensive typewriter, and you can insert remarks into text which won't be printed out. Other interesting features include numeric justification, multi-column printing, the ability to link documents together for printing and the capacity for up to five footnotes per page.

Built into the system is the ability to compile a file of standard paragraphs, each of which is given a label. You can then draft out, say, a letter to incorporate one or more of these paragraphs, except that you merely put the label in the desired place; Memorite then automatically merges the appropriate paragraph into the text at the appropriate place. Names and addresses from the mailing list facility (see below) can also be inserted automatically into text.

Page headings and footings, incorporating the page number in whatever position you want, can be defined and printed automatically. It's possible to define separate headings for left and right pages, if you're preparing camera-ready artwork for a book.

Mailing list

Memorite includes a mailing list facility, but it's in Microsoft Basic; fortunately MBasic comes with the machine. It's a suite of programs, driven from a master-menu, which allows you to create/delete a mailing list, edit/display one, print it either as a list or on labels, or sort it by any criterion you choose — you're allowed to insert category codes when building the list.

The powerful sort program is a CP/M command program, not a Basic one, and seems pretty fast; unfortunately time didn't allow me to build up a large enough file of names and addresses to produce any meaningful figures for the sorting.

The mailing suite seems well thought out, is user-friendly and easy to use, with the mild exception of the label printing section. In order to cope with the massive ranges of sizes and shapes of labels, the program requires you to detail the label formats very carefully and specifically. It looks complex at first and requires a little experimentation, but, once mastered, isn't as formidable as it at first appears.

I could find no reference in the documentation to any maximum length of mailing list. Given the megabytes of hard disk on the 3005, you could build up a really massive list and use the sort program to produce categorised sub-lists as required. Back-up copies would be a problem, though, if the list exceeded the capacity of a floppy disk — more on this in a moment.

Other software

Vector Graphics produces a range of other software for business applications. I was loaned a copy of one of these, a Visicalc-like planner called Execuplan. Time didn't allow a thorough review of this, and in any case it's beyond the scope of this review, but it looked powerful (VG says it has more facilities than Visicalc) and its output can be saved on disk and linked into Memorite text files, which is exceptionally useful for the business report-writer. Vector Graphics also markets a nice Othello-type program, which I only managed to beat once and which could take up a lot of your time if you're not careful.

Users

Of our four hypothetical users, I feel that the business/technical report writer will find the system most useful, mainly in view of the other VG software available for the machine, especially Execuplan.

For general business users, the system would also prove exceptionally useful. As a word processor, it compares very favourably with dedicated machines on the market — one, selling at around the same price, gives you only a single floppy disk, for example, while the 3005 has that hard disk as well! It doesn't have the special function keys, of course, which you'll find on most dedicated machines, but if I was buying a word processor for commercial use now I'd certainly put the VG very high on the list.

For the author/journalist, it's a little more difficult to give a definite yes/no. As I've said before, this user would

The Microwriter has two registers (as the manual calls them): 'alpha' and 'punctuation'. At power-on the machine is automatically in the alpha register, in which all letters of the alphabet plus the most commonly-used punctuation marks — full stop, comma, hyphen and apostrophe — are available. Pressing the control key by itself latches the device into the punctuation register (denoted by a Union Jack-like symbol on the display) where numerics and other punctuation marks are available together with such symbols as '&' and '%'; in fact all the symbols you normally find on a typewriter are available on the Microwriter except for fractions. In this mode, the control key has a toggle action — pressing it again puts you back in the alpha register.

There are separate learning cards for punctuation and numerics and, again, a lot of thought has gone into making the learning process easy. The pounds sign requires the same key combination in the numeric register as that which, in the alpha register, produces 'L', for example (although the resulting display character looks a little odd). Similarly, '?' uses the same combination as 'Y' (mnemonic 'why?'); and numeric '0' is the same key as letter 'O'.

The Microwriter control key also functions in combination with other keys to allow a range of control commands to be executed. This is mostly achieved using letters whose combinations normally include the thumb key, except that the control key is used instead. Again, care has been taken to make them easy to remember. You press CTRL-J to jump back through text, CTRL-I to insert text, for example. Many commands can be extended by first typing CTRL-Y; so while CTRL-F moves the display forwards by one character, the sequence CTRL-Y,

by a Union Jack-like symbol on the display) where numerics and other punctuation marks are available together with such symbols as '&' and '%'; in fact all the symbols you normally find on a typewriter are available on the Microwriter except for fractions. In this mode, the control key has a toggle action — pressing it again puts you back in the alpha register.

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TEST AUTHOR P 1,849 CHARACTER(S), 28,321 REMAINING
TEXT ACTIVE PRINTER N7700 DRIVE ASSIGN (A) PROGRAM (B) DOCUMENT

GENERAL REFERENCE

(AUXILIARY COMMANDS)

AUXILIARY COMMANDS

Type "HA" for general help in the auxiliary area. The auxiliary command mode is entered from the editor by depressing CTRL AJ. This list shows all the auxiliary commands, one per line with its entry format. For more detailed information on a command, type "HA ", followed by the command's first letter. The commands are grouped as follows:

"C" - Copy commands	"P" - Print commands
"D" - Display commands	"Q" - Quit commands
"F" - Find commands	"R" - Remove commands
"H" - Help commands	"S" - Set commands
"I" - Initialize commands	"W" - Write commands
"M" - Merge commands	"X" - Miscellaneous commands

[DOWN ARROW] = NEXT PAGE [UP ARROW] = PREVIOUS PAGE [ESC] = EXIT

Top: The screen during editing. Centre: the status bar which appears in the command mode. Bottom: one of the 'help' screens which explain Memorite's commands. This one's the master 'help', a guide to the others!

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really like a machine which uses virtual memory techniques — as the text buffer fills up, text is automatically saved onto disk so you can work on a much larger document than will fit into the buffer. In turn, this allows you to skip back to see what you wrote 20 chapters earlier without saving the current file on disk and loading the earlier file. I have such a system at home, based on minifloppy disks; while it's very useful, it suffers from the slowness of floppy disks, especially inconvenient when writing to disk, and from the eventual limit on the amount you can get onto a floppy. With the hard disk, both these drawbacks disappear — hard disks are quick and hold a lot. It's a real shame that the Vector doesn't incorporate this facility, for that would make it into an author's 'dream machine'. The remaining objection, that of storing a several megabyte long piece of text onto floppy disks for security purposes, could be overcome.

Hardware

The Vector Graphics machine is nicely made, has a good, solid feel to it and would look at home in any office environment. The keyboard is of typewriter layout and pitch and the display is particularly pleasant: it gives 24 rows of 80 characters and, although a little small, is very clear, with true descenders on letters like 'p' and 'q'. The screen has an anti-reflective mesh in front of it and there's a brightness control at the back of the machine.

And that hard disk? If you've never used one, you can't imagine how nice it is. Firstly, it's incredibly quick — take a look at the WP Benchmark timings with this review. And it holds a *hell of a lot* of files. The disk is actually divided into two as far as the system is concerned — it looks and is used exactly like two enormous floppy disks. Each 'side' of the hard disk has 2408 kbytes available to the user, roughly 764 A4 pages of text per side! The minifloppy disk has a 298k capacity, approximately 94 pages, which puts things into perspective. The system was set up with CP/M on the hard disk, from which it booted up from the monitor in under a second.

Hard disks are very much more reliable than floppies but it would be extremely foolish to expect total reliability from them — there's always a danger that they might fail and you *must* make back-up copies of your files onto floppy disks — some 16 floppies would be needed to back up the entire contents of the Vector's hard disk, theoretically, but in practice you'd use more than that number.

You don't, of course, need to make a back-up copy of a file *every* time you change one; it would be sensible to work out a backing-up frequency that depends on how much work you do and how many hours' or days' work you can afford to lose if the hard disk crashes before you've made back-ups.

The printer which came with the system was the new NEC Spinwriter 7700, a thoroughly pleasant machine producing very high-quality print from even a nylon ribbon. It's fast and quiet (both by daisywheel printer standards) and has a claimed 27 per cent fewer components over the previous Spinwriter; it's still bloody heavy to move around, though.

Talking of moving things around brings me to my only major criticism of the Vector Graphics hardware — the way in which the three modules (computer, disks and printer) are connected together. Firstly, the connections use broad ribbon cables, one for the printer and three for the disks, which not only look out of place in an office but which have a knack of tangling themselves up untidily. Worse, though, is the fact that you can only connect and disconnect them by opening the computer and unplugging them inside — there are no sockets on the outside of the computer for them. This means that moving the system around is a four-person job; two for the printer and one each for the computer and disks, unless you're prepared to open the machine.

Summary

Memorite III is a well-designed word processing package which would be of use in general business and report-writing applications but less attractive to the author/journalist, unless the latter was considering a dedicated machine, in comparison with which Vector gives exceptional value for money.

The hardware is well made, apart from the connections arrangement which needs rethinking, and the NEC Spinwriter, newly available in this country, is a very civilised machine and a definite improvement on the earlier Spinwriter.

WP Benchmarks

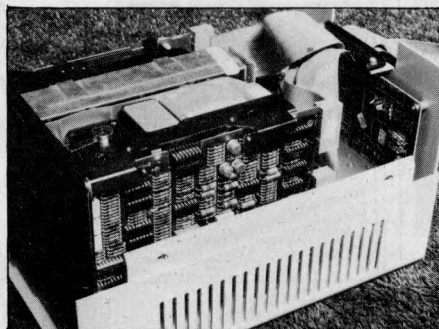
- | | |
|---|-----------------|
| 1 | 3.4 (6.0) |
| 2 | 6.1 (54.9) |
| 3 | } instantaneous |
| 4 | |
| 5 | 3.3 |
| 6 | 3.3 |

All timings in seconds. Benchmarks 1 and 2 (load and save text) were carried out using the hard disk — times for the same tests with the floppy disks are in brackets. For an explanation of the WP Benchmarks, see April 1981 *PCW* (Vol 4 No 4), page 86.

Prices

Vector Graphics 3005	£4750*
NEC Spinwriter 7700	£2250
Memorite III (includes SPELL and mailing list)	£375
Execuplan	£150

*Includes CP/M and MBasic.
Prices exclude VAT.



Inside the disk drive unit. The hard disk is the nearer unit, with the floppy behind. Note the three broad ribbon cables which connect to the computer.

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Volume 3 No 6
June 1980
Benchtest: Tandy TRS-80 Model II/Benchtest: Sintrom Periflex 630/48 / Staff case study/Checkout: Softy Intelligent EPROM Programmer/Checkout: Exatron Stringy Floppy/ Practical examples of the IEEE-488 bus use/ Programs: Naming Nascom files, 380Z Pictures, Fuel tank calculations — PET, PET large numeral generator, PET tank battle, Basic string handling routines/Pascal: Final instalment.



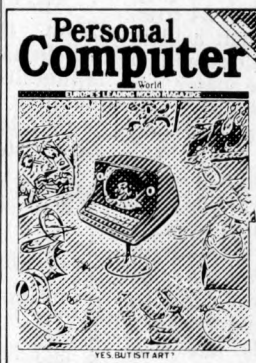
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Benchtest: BASF 7120/ Checkout: Hi-Tech S100 colour VDU board/ Secrets of systems analysis — Part 1/Sub set — part 1/Benchtest: CBM's 'SuperPET',/Programs: PET Dots & boxes, PET Bloobers, PET Demolition, Apple Showpiece, PEEK & POKE for Apple & Pascal, PET Giant Slalom, Speed & Acceleration.



Volume 3 No 10
October 1980
3-D graphics/Benchtest: Atari 400 & 800/Benchtest: DAI/Robotics/ Benchmarks/Programs: PET Racer, PET Fighter Pilot, UK101 Graphics, Apple Plotting, UK101 Gunfight, PET Algebraic evaluation, ZX80 Breakout



Volume 3 No 11
November 1980
Benchtest: the SBS-8000/ Announcing Computertown UK!/Apple/ITT 2020 Colour graphics/Imp printer/Programs: PET Ski, MZ-80K Bouncing ball, Superboard-UK101 Bug bypass, PET Replace



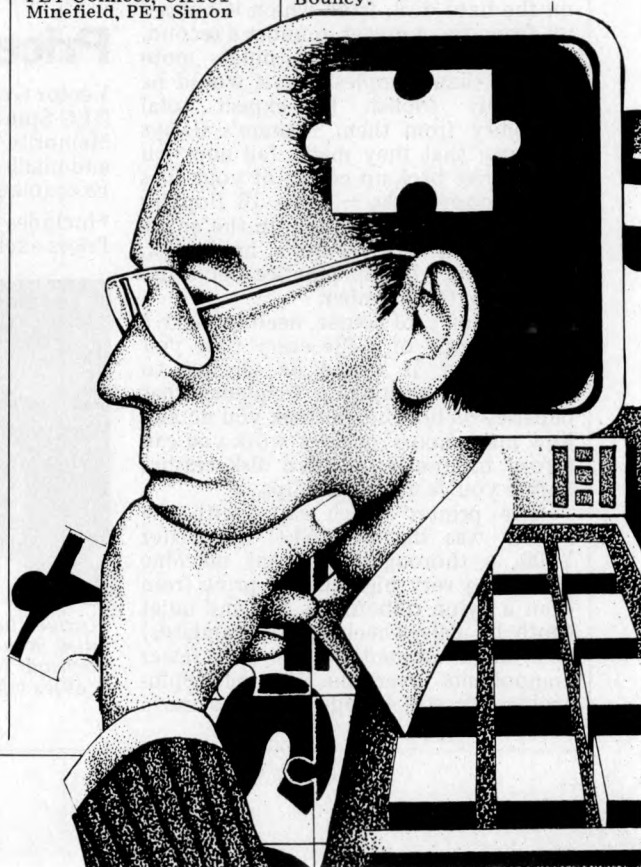
Volume 3 No 12
December 1980
Benchtest: Microwriter/ Printerfacing: Series — Part 1/Sharp PC-1211 speed-up/Programs: TRS-80 Tarot, PET Cat & Mouse, PET Rebound, MZ-80K Alligator Swamp, PET Connect, UK101 Minefield, PET Simon



Volume 4 No 1
January 1981
Benchtest: Transam Tuscan/Real-time control using trains — part 1/ Recover from a data tape disaster/PET Music/ Multi-user systems — part 1/Programs: TRS80 Four in a row, TRS80 Target Practice, PET Convoy, PET Wire, PET Maze Chase, PET Android Attack, PET Anagram



Volume 4 No 3
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Benchtest: Onyx C8002/ Benchtest: Bigboard/Micro music software package/ ALC circuit/Commons report/HP 34C/Programs: TRS80 Show Jumping, PET Grand Prix, PET Aircraft landing, PET Bouncy.





Volume 4 No 4
April 1981
 Benchtest: ABC 24/
 Slow scan TV/IDPM/
 Word processing: Bench-
 tests/ZX80 books/
 Commons report/Casio fx
 3500p/Programs: ZX80
 Maths Test, ZX80 Calen-
 dar, PET Link Index,
 ZX80 Moon Lander, TRS-
 80 Rocket Attack, TRS-80
 Dropout, PET Giant
 Trap.



Volume 4 No 5
May 1981
 Benchtest: Pasca 640/
 WP Benchtest: Magic
 Wand/PET colour/Low-
 cost digital tape system/
 Using calculator printers
 on micros/Apple music-
 making/Multi-user Bench-
 test: MVT-Famos/Pro-
 grams: PET Grand Prix,
 PET Aircraft Landing,
 PET Bouncy.



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June 1981
 Benchtest: NEC PC-8001/
 Multi-user Benchtest: MP/
 M/Benchtest: Sinclair
 ZX81/West Coast Faire
 report/Radio Teletype/
 WP Benchtest: Wordpro
 4 Plus/Budget tape inter-
 face/Further Casio quirks/
 Programs: UK101 Zor,
 PET Chords.
Volume 4 No 7
July 1981
 Benchtest: Sharp PC-3201/

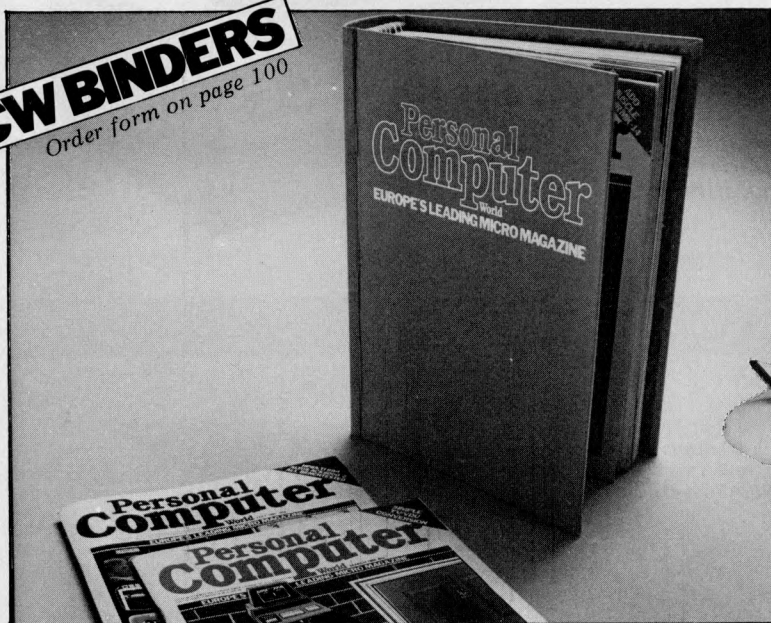


Multi-user Benchtest: Acorn Eonnet/Case study: Accident investigation on TRS-80/Zilog Z8 family
 WP Benchtest: Format-80/
 Pascal Benchmarks: readers' letters/Quicker Casio com-
 putations/Programs: ZX80
 Sliding Letters, UK101 Car
 Rally, TRS-80 Calendar,
 UK101 m/c code to Basic
 converter, PET Exam
 Questions, MZ-80K
 Designer, ZX81 Sketch
 Pad.



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August 1981
 Benchtest: Tandy Model
 III/Viewdata update/WP
 Benchtest: Spellbinder/
 Printer survey/Micro-
 holism/Programs: ZX80
 Othello; Easter Sunday;
 Apple Mondrian; MZ-80K
 Duck Shoot; PET
 Gomoku; MZ-80K Foot-
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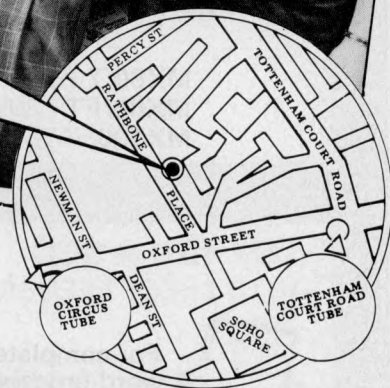
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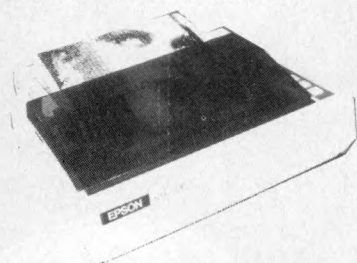
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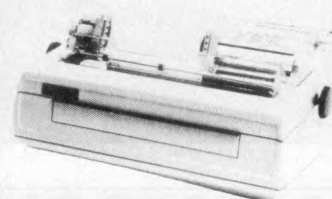
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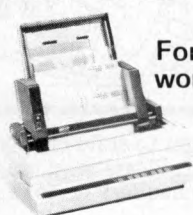
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INCREASE YOUR WORDPOWER

Fed up with playing 'Invaders' on your PET? Try getting to grips with this word processing program from Kevin Pretorius

Most of you with microcomputers and printers must have considered at some time or other how convenient it would be to have some wordprocessing power on your system. If you own a popular machine, then someone may have already written a wordprocessing package for you but the chances are that if it's good, then it's also expensive. Alternatives to buying one (other than piracy), are managing without or writing your own. I've taken the last option, and wordpower is the result.

In this article I'll be talking about the features that Wordpower offers, how to make use of them and, most importantly, how it works. Hopefully, there's enough material here to point you in the right direction if you fancy developing your own, but for the remainder of you, a complete listing has been included.

If machine code turns you a funny shade of blue, take heart, as Wordpower is (almost) entirely written in Basic, for reasons that I'll describe shortly. For editing text, Wordpower is still pretty quick, about as fast as I can type but it's definitely not for the lightning touch typist. Printing justified, formatted text can, however, take a few moments and I'd recommend that you find something else to do (like read *Lord of the Rings*, or *War and Peace* — or both!). In fact, Wordpower can just about manage 45-50 words per minute (in short bursts) and takes about 10-15 minutes to print a typical A4 page.

So why was Wordpower written in Basic? Well, in the beginning I was uncertain of which features would prove to be the most useful in a word-processing system and of the best way to tackle the problem. Programming in Basic allowed substantial revision and experimentation to be carried out as my ideas on the subject developed. If machine code had been used from the outset, it is doubtful that Wordpower would ever have been finished! Additionally, there is the extra advantage that now you, the reader, will have far less trouble following the final listing.

Originally, Wordpower was coded entirely in Basic but it was quickly realised that when editing text, a great deal of time was taken up in moving large blocks of characters up and down in memory. Therefore, two very simple machine code routines were added (COPY UP and COPY DOWN) to shift text about rapidly and these have brought the response time of the program down to quite an acceptable level.

Professional wordprocessing packages are expensive for several reasons, not

the least of which being the sheer size and complexity of their machine code. They typically offer a wide selection of powerful editing and formatting commands and often run on a large number of microcomputer printer combinations. This facility is necessary to sell to a wider market and a large number of features makes a product sound better than its competitors.

Wordpower only has to run upon my system (a 3032 PET and Epson TX80) and provide the commands that I feel are directly useful in my applications. I don't need to handle enormous documents. I don't expect printout at 60 lines per minute and I don't require address and letter merging facilities! In fact, I strongly suspect that a large body of wordprocessor users only employ a small subset of a wordprocessor's commands anyway.

Features

Now let's briefly discuss the features that Wordpower does have and how to use them. First, Wordpower can hold about 20,000 characters (about 3500-4000 words) of text in memory (on a 32k PET) and can LOAD or SAVE named text files onto disk. Editing functions are called by single keystrokes such as I to insert text or D to delete. A menu of the options available to the user while editing is always on display in reverse field at the top of the screen (see photo 1).

A cursor is displayed which indicates where editing will take place. Cursor control keys are used to move the cursor and the display is scrolled automatically whenever the cursor would otherwise leave the screen. Cursor Home is available and a Cursor Away has been added (instead of Clear Screen) to drive the cursor to the bottom right of the screen. To move more quickly through the text, touch the N or P keys (Next Page & Previous Page). These will cause the display to scroll forwards or backwards by one screenful.

To insert text, merely position the cursor appropriately and strike the I for insert) key. Wordpower will allocate three blank lines in which to type the text (see photo 2). When this space has been filled, it will automatically allocate another three lines. A carriage return will bring the user back into editing mode and close up any unused space.

Deleting text is just as easy. Position the cursor over the first character to be deleted, strike the D key and use the cursor control keys (including cursor home and away) to define the text area to be removed (this will appear in

reverse field. Type carriage return to complete this action. There is no limit to the size of text you may delete and it is quite permissible to continue past the end of the screen display — it will scroll automatically.

Should you decide that you have deleted something in error, type C to copy back the text. The last item deleted is temporarily stored at the top of RAM, until overwritten by the next deletion. This arrangement provides a neat method of moving a block of text from place to place. Merely delete the block, then copy it somewhere else after repositioning the cursor.

The copy command is also useful when printing large documents which are split over several files. The first file should be printed and will presumably end on a partly-used page. This part page can be found and deleted, using the D key. The second file can now be loaded, and the copy command used to insert the part page at the beginning of the second file. Printing may now continue.

To correct those single character, miskeying errors, rather than having to use the two operations delete and insert, exchange has been provided, allowing the user to overwrite what he sees upon the screen. Again, carriage return completes this operation.

Finally, a write option allows the user to write to the printer or to preview the formatted text on the screen. Output is divided automatically into pages and the option to continue or finish is given after each page. This allows the user the opportunity to return to the editor, if he has spotted an error, or to turn the paper over, if he requires both sides to be printed on.

An important point to bear in mind is that printing starts from the position indicated by the cursor, not necessarily from the beginning of the text. This method is preferred as it allows any section of the text to be formatted, without having to wait for previous sections to be completed first. This is especially handy where only a single page needs reprinting, for example.

Prior to printing, the user may select options to right justify, double space, or number the printed pages. To those of you who may not have met the term before, 'right justification' is a process where the right hand edge of a document is lined up nicely and avoids the otherwise 'ragged edge' look of manual typing. The default values for the left and right margins may also be changed at this point. Right justification and double spacing are selected by a simple yes/no response

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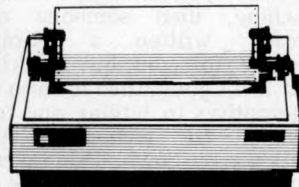
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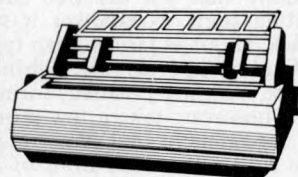
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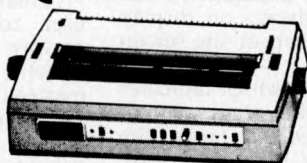
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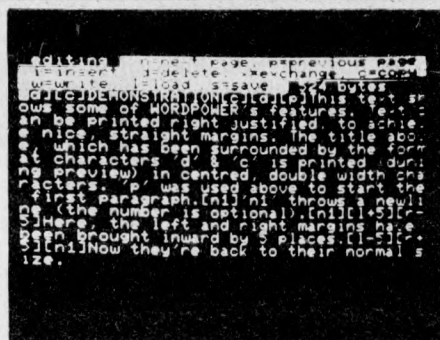


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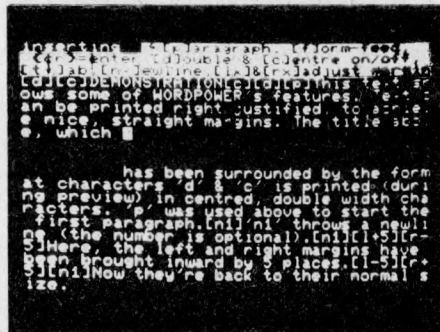


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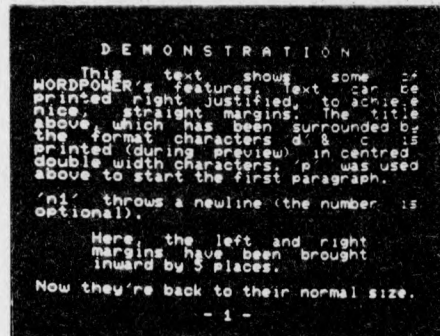


Photo 3

and pages are numbered automatically on wards from the figure typed in reply to 'page number?' If 0 is entered, pages are printed without numbers.

For formatting, a number of special characters may be included within the text (enclosed by square brackets). Each of these is listed (in reverse field) at the top of the screen during inserting, deleting, and exchanging modes (again, see photographs). Examples of these are: P for start paragraph, N for new line, and F for form feed. I hasten to add that line breaks and page boundaries are inserted correctly during printout but there are occasions when you would wish to force a new line (eg, at the end of a title) or formfeed (eg end of chapter).

In some cases, numbers may be included with this format information, such as when tabulating or when throwing several new lines. Tx signifies tab and behaves much in the same way as Basic's PRINT TAB (a). Similarly, Nx may be used to print x new lines. Other characters allow double-width printing, and centred text (you might use both in conjunction to display a title or heading). The first occurrence of D or C turns on the mode, while the second turns it off again. The left and right margins can also be adjusted, to achieve indented subsections for a report, or even narrowed text width for quoted paragraphs, etc. Lx and Rx move the margins x places to the right, while L-x and R-x move the margins leftward.

How it works

That just about covers the features of Wordpower and brings us to the nitty-gritty of how it works and how you might approach writing your own. The first — and most important — decision to be made, is how the text should be stored. The normal facilities provided by Basic, fall far short of the ideal for this particular task.

In PET Basic (and I suppose many others), strings can be a maximum of 255 characters in length and only 78 characters can be entered into a string using an input statement (because of line length problems). If strings were used, the word-processor software would have to prevent 'string too long' errors from occurring, when new information has to be inserted into a string, which could call for some pretty fancy algorithms and data structures. Maintaining a sensible display, holding together the data structure under conditions, formatting the output and devising ways for the user to modify text would be a formidable task indeed.

One possible solution would be to use only strings of one character long and to link them together in a list via pointers. At least this structure is a nice homogeneous one and should present few management problems. Unfortunately, the storage needed for the pointers would rapidly eat up memory space and only permit a very small text buffer to be edited.

These considerations have brought me to the conclusion that the best approach is to treat the text as one continuous string (yes, of up to 20,000 bytes long!). This implies that storage management can no longer be left to the Operating System (OS) and that a part of RAM be hidden from the OS and be managed entirely by the word-processing software.

How's it done? Well, the new ROM PETs use locations 53 & 52 (old ROM = 135 & 134) to point at the highest location in RAM, and if POKED with a lower value, the OS will not use memory locations above this. Additionally, the pointer to the bottom of string storage at locations 49 & 48 (old ROM = 131 & 130) needs initialising to the same value. On a 32k machine, locations 53 & 52 would normally contain 128 & 00 respectively, but in Wordpower, these are readjusted to 46 & 00. Therefore (128-46)*256 (ie, 20992) bytes are available for text manipulation.

Wordpower uses a number of pointers for editing and the most important of these are illustrated in Figure 1.

In the opening lines of the Wordpower listing, Home, Mid and Away, are initialised as fixed pointers into the screen memory of the PET. Start, Fin and Dest are variables shared by the machine code and Basic routines. Poke 59468, 14 puts the display into upper/lower case mode and the machine code copy routines are loaded into RAM (subroutine 9900). Text Start (TS), & Text Finish (TF) are initialised to the limits of the text buffer, and Text Pointer (TP) is set to the first location. The top of memory and bottom of string pointers are adjusted before any strings variables are used, in lines 90 & 100.

The screen display is maintained as a window upon the text buffer, and Wordpower has been written so that all changes made to the display effect an identical change in the text. Display Start (DS) and Display Finish (DF) demark the displayed area within the text buffer. The Display Pointer (DP) is always kept in step with the Cursor Pointer (CP) so that wherever the cursor is positioned upon the screen, DP points at the corresponding location in the text buffer.

The edit routine (lines 1000-1999) first prints a menu at the top of screen and calls the display subroutine to provide a text display. It then calls routines to flash the cursor, get a character, obey cursor controls and then hands out work to the insert, delete, exchange, etc, subroutines, as needed.

The display subroutine (2000-) updates the screen display by copying up 800 bytes (from DS onwards) from the text buffer. This byte shifting is delegated to the machine code copy routines by passing them start, finish and destination parameters. Problems to watch out for occur when the end of the text buffer is on display. We must ensure that no garbage remains on the screen, as the end of text scrolls up, and that no garbage past the end-of-text finds its way onto the screen. I've tackled this problem by appending up to 800 spaces onto the end of the text buffer (whenever this is displayed) and copying a full screenful up in one go. This avoids the 'juddering' or 'flash' effect of other techniques I have tried.

The flash cursor and get CH\$ subroutine (9000-9099) achieves its task by continually polling the cursor position (CP) with a white square until

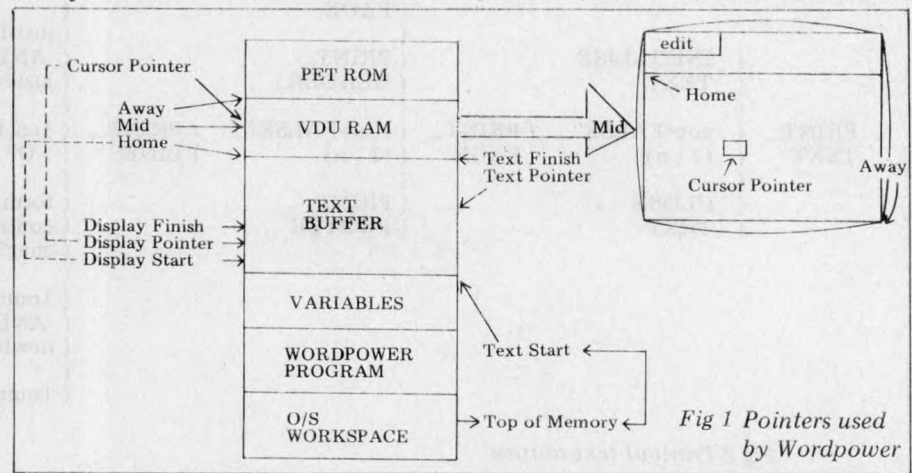


Fig 1 Pointers used by Wordpower

a key is pressed. It also returns the ASCII value of the character in CH.

The subroutine (9100-9199) serves to obey such characters and sets CC=TRUE if a non alpha-numeric key has been pressed. Where CP moves beyond the screen area (ie, beyond HOME or AWAY), subroutines to scroll the display are called. Excursions of the display pointer (DP) are limited to not exceed TP (so that the user doesn't attempt to insert where he shouldn't!) and the values of DP and CP are always kept in step.

The insert routine (2500-) has to provide space for new characters to be inserted. To do this, it calls the machine code copy routines to shift any following text up by 120 bytes (three lines) and to write blank spaces into the gap created. After ensuring that the working area is on a sensible part of the screen (ie, not in danger of going off the bottom) the display routine is called. Thereafter, text characters are inserted as received, and DP and CP advanced (2700-). Prior to insertion, each received character code has to be converted from ASCII to its screen value. With the PET these are not the same. The necessary bit manipulation is performed in line 2650.

The arrival of a delete character causes DP and CP to be decremented and a space overwrites the previous character (2800-). A carriage return (to terminate entry) shifts the following text back down to meet the last character inserted (2750-). If 120 characters are received, the program jumps back to the start of the insert routine to allocate more space (2850-).

The delete routine (300-) has to provide a reversed display (ie, black character on white background) of the text buffer are replaced after ORing them with 128 (3310). When the cursor is moving backwards, these bits are reset again (3210). The Display routine is continually called to keep the screen updated. When carriage return is typed, the text to be deleted is first copied up to the top of RAM (to be used by the copy facility, if needed) before the following text is brought

down to overwrite it (3400-). Note that the machine code to copy upwards has therefore to reset bit 7 to avoid reversed text from being reinserted by the copy command.

This bit resetting and continuous display refreshing could be avoided by reverse fielding the display only. Unfortunately, this makes the correct display very difficult to maintain where scrolling is brought about by the user deleting past the bottom of the screen. Finally, the display is checked to see whether the edit start marker (ES) is still in the display area (3470). After scrolling, this may no longer be true, and suitable scrolling back may be needed.

The exchange subroutine (3500-) is a simpler version of the insert subroutine but has no need of text shifting.

Next page (4000) and previous page (4100) call the scrolling functions of lines 4500-4699 to manipulate DS, DP and CP correctly. Checks are made as usual to ensure that only sensible ranges are permitted for these quantities. Note also that next page is not identical to scroll up 20 times — the former keeps CP where it is and adjusts DS and DP while Scrolling adjusts DS and CP only, leaving DP static.

The copy down subroutine (5000-) is very simple. It shifts up any following text by the required amount, and copies down the previously deleted text (stored at the top of RAM) to fill in the gap.

Save and load from disk also need little explanation. A byte count, calculated from TP-TS, is stored prior to writing the entire string to the device. Although I have not done so, here again is a simple task that could quite easily be sped up with a short assembler program.

Formatting

Before embarking on a description of how Wordpower tackles the formatting, it will be advantageous to first clarify the task at hand. The text data is currently stored as one long sequence of characters, interspersed with format

control commands enclosed within square brackets. This text string needs to be divided into lines of a certain maximum length, (ie, the page width) with as many words as possible on each line. Lines may only be broken on spaces or hyphens and will be cut short where any control character (except tab) is met, or when the end-of-text has been reached.

Page breaks must occur where the maximum number of lines have already been printed on a page, or where form-feed or end-of-text have been encountered.

If justification has been selected by the user, extra spaces will need to be inserted into most lines to straighten the right-hand margin. Clearly, titles should not be justified, nor other lines which are shorter than normal, such as the last in a paragraph (but not the first!). Similarly, lines containing tabs and lines to be printed in the centre of the page should be left alone.

Earlier, it has been mentioned that the PET screen codes and ASCII are different. The truth is that the Epson TX80 codes are different yet again and further conversion is required. A problem also arises with regard to double-width printing — the Epson has it, the PET hasn't. The best way to present this when previewing the text, deserves some thought.

Finally, the provision of double-width printing, centred text, adjustable margins, automatic paragraph indentation and tabulation, does complicate the formatter considerably and the first-time programmer may care to omit some of these features from his initial version.

A Warnier-Orr diagram, depicting the overall structure of the formatter, is given in Figure 2. From this it can be seen that the high-level structure is identical to that of the document to be printed. That is, printing text is a matter of printing a number of pages. Printing each page requires printing a header, a number of lines of text and a footer. At a lower level, however, this pleasing parallel breaks down as the detailed formatting needs of each line are

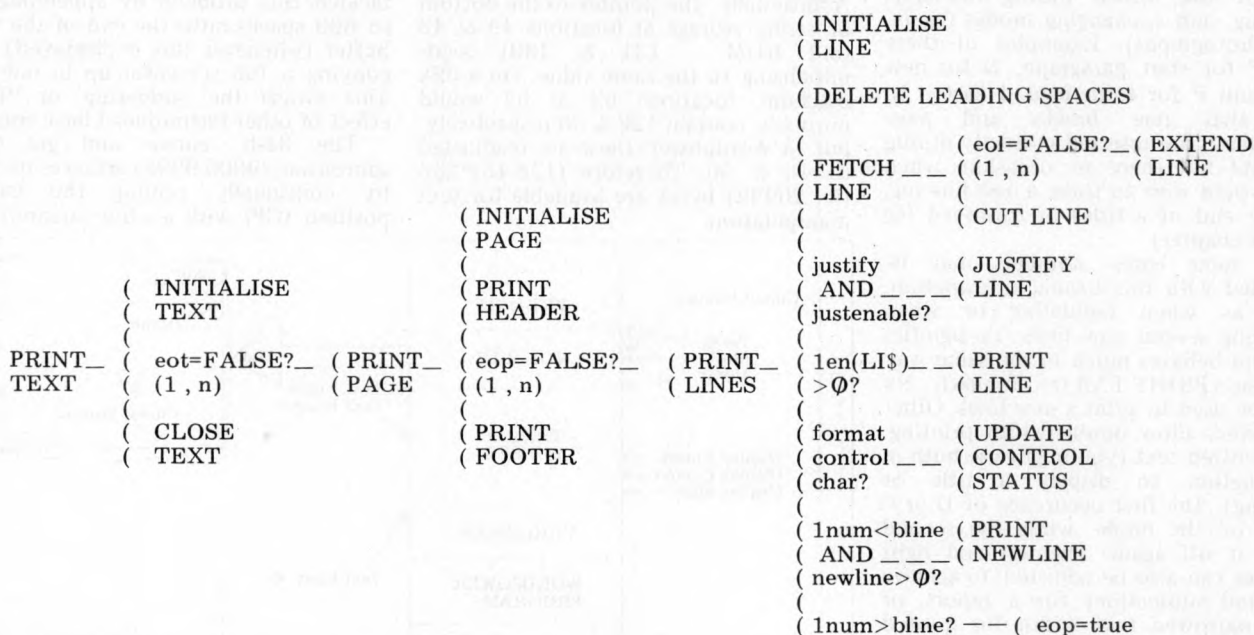


Fig 2 Printout text routine

attended to.

In the process of printing text, characters are fetched from the text buffer, converted to ASCII and used to build up each line in LI\$. LP (for Line Pointer) indicates the position of the next character to be fetched and is initialised prior to printing from the value of the Display Pointer, DP. End-of-text, end-of-page, and end-of-line flags (XT, XP & XL) are used in an obvious manner to control the major loops of the formatter (see Figure 2) and a format status is maintained which holds such current information as whether a line should be printed in double-width characters, justified, or centred on the page.

Let's look at the level of printing a line (6800-). After some initialisation, the first thing to do is to remove any leading spaces there might be on the line. Otherwise, the left margin on the printout could end up looking ragged. Characters are then fetched from memory, one at a time, and are used to extend the string LI\$. This process continues until one of three events occurs. The most common is that LI\$ becomes long enough to fill the required text width, whereby end-of-line (XL) is set (7130) causing the program to branch to the next stage. Alternatively, we may encounter the end-of-text, which would set XT, XP and XL to TRUE and disable justification (by JE = false) (7720).

The third possibility is that a control character will be met. In all cases except tab, this too will signify the end of a line. The control character and any associated numerical information (referred to in the listing as Key and Keyvalue — KEY\$ & KU) are extracted the hard way (see lines 7030-7110) and the results stored for later action. Only tab meets with an immediate response by inserting the relevant number of spaces.

Once the line has been fully extended, the next task is to find a suitable place in which to cut it. To do this, the character that would follow the line (presently held in CG\$) is examined to see if it is a space or a square bracket, whereby the end of the line already matches the end of a word and may pass uncut. Otherwise, the program repeatedly adjusts the line pointer (LP) so that earlier characters are examined and compared with hyphens, spaces or closing square brackets (there could be a tab) until a suitable place to cut has been found. Note that a line should be broken after a hyphen but before a space or square bracket. Hence, testing for hyphens is not performed until we start searching backwards. If a suitable place to cut is not found (sometimes this occurs when previewing a long underline) then LP is restored to its former value and the line is passed uncut. The code to perform this task starts at line 7200.

If Justify Enable (JE) has not been reset by the occurrence of a control character or end-of-text and Centre Text (CN) is not in operation, then justification may proceed. After checking that at least one space is present, SL (Space Locator) is advanced from an arbitrary starting point within the line until a space is discovered. There, an extra space will be inserted and SL advanced until the start of the

next word is found. If SL should exceed the length of LI\$, then it is wrapped around back to the start once more. This cycle of find a space, add another, find next word, continues until the length of LI\$ reaches the desired Text Width. This simple algorithm produces quite an acceptable distribution of spaces throughout the printed page and is located at lines 7300-7399.

Following justification, the line can then be printed. It is possible that the line has nothing in it (where two control characters have occurred in sequence for example) and so the length of the line is checked in 6940 before calling the print routine (7800-). This routine has to calculate the required margin width (MW) before it outputs the line of text, by a quite complex formula involving the Centre Text, Double Width and Start Paragraph flags (CN, DB, & PA), the Text Width, the length of LI\$ and the default position of the Left Margin.

If the output is to be directed at the printer, then each character has to be converted to Epson code from ASCII. This occurs in lines 8000-. The statement PRINT#, CHR\$(1) serves to instruct the printer that this line is to be printed in double-width characters.

If the output is to be directed at the screen and double width printing has been requested, then Wordpower does the best it can to display this by inserting a space between each letter.

Before continuing onto the next line, KEY\$ is checked to see if it contains any new formatting information. If so, then update status is called (7600) to tweak the values of Newline, Lmargin, and Rmargin and to set or reset the Double, Centre or Start Paragraph flags as dictated by the latest control character. In Wordpower, format control commands take effect upon the following lines (as opposed to the current).

If any new lines are required, they are printed next and the final operation for each line is a check to see if the line number has exceeded the bottom line, whereby end-of-page is set to TRUE.

Son of wordpower!

That completes this somewhat cursory (no pun intended!) introduction to what is in effect a quite tricky pro-

gramming problem. The (supposed) structure and simplicity of the final working code and user interface is the result of many rewrites from scratch. Be warned! Nevertheless, I hope that some of you will be encouraged to write a version for your own systems and that this discussion has been of some help in providing a few ideas and suggestions. For my part, by the time you read this, I fully expect to be halfway through the machine code version. Remember that the Basic version was of an explanatory nature and now that I have a firm idea of what I want (and how to write it!) I can proceed with confidence.

The machine code version will, of course, be much faster, and will also allow improvements in other areas.

Professional wordprocessing systems allow a document to be edited as it would appear upon the printed page. During insertion, each time the cursor disappears beyond the right hand margin position, the line is cut, justified, and formatted, appropriately. Such interactive editing is highly desirable but far beyond the real-time capabilities of interpreted Basic. The arrangement adopted in Wordpower (ie, separate edit and preview modes) has been chosen in recognition of this fact. This facility becomes feasible when machine code formatting routines are used.

The limitation (on my machine) of a 40-column display prohibits a true preview of the formatting for an 80-column printer. What could be done, however, is to provide the interactive formatting described above, using only 40 columns and offer a preview mode where full 80-column formatting can be viewed, using left and right scrolling as well as the usual up and down. This feature exists on some wordprocessing systems to allow even 132-column printouts to be prepared.

The listing in full accompanies this article and I hope enough information has been given in the text and the diagrams to satisfy those who might care to use or understand the problem.

Listings are available on cassette from the author, price £4.50, on application to: Kevin Pretorius, 53. Firs Park Ave, Winchmore Hill, London N21 2PR.

Wordpower

```
10 TRUE=-1:FALSE=0:POKE 59468,14
20 SART=826:FIN=828:DEST=830
30 HOME=32888:MID=H0+400:AWAY=H0+799
35 :
40 PRINT"*****TAB(12)"ORDPOWER '81"
50 PRINT"■TAB(10)"BY KEU "ETORIUS"
60 GOSUB 9900
65 :
70 TS=46*256:TF=128*256-1:TP=TS
80 DS=TS:DP=DS:CP=HOME
90 ADR=48:DAT=TS:GOSUB 9900
100 ADR=52:GOSUB 9900
105 :
110 H$="■ [PARAGRAPH, [FORM-FEED, <CR>=ENTER, [DOUBLE & [CENTRE ON/OFF,"
120 H$=H$+" [TX]AB,[NX]JEWLINE,[LX]&[RX]ADJUST MARGIN"
130 SF$=""
135 :
1000 REM ** EDIT TEXT **
1010 PRINT"■ EDITING ■ N=NEXT PAGE, P=PREVIOUS PAGE ":
1020 PRINT" I=INSERT, D=DELETE, X=EXCHANGE, C=COPY ":
1030 PRINT" W=WRITE, L=LOAD, S=SAVE ■:TF=TS"BYTES"
1035 :
1040 GOSUB 2000 : DISPLAY
1050 GOSUB 9000 : FLASH & GET CH$
1060 GOSUB 9100 : CURSOR CONTROL
1070 IF CC=TRUE THEN 1050
1075 :
1100 IF CH$="I" THEN GOSUB 2500: GOTO 1000
1110 IF CH$="D" THEN GOSUB 3000: GOTO 1000
1120 IF CH$="X" THEN GOSUB 3500: GOTO 1000
1130 IF CH$="N" THEN GOSUB 4000: GOTO 1040
1140 IF CH$="P" THEN GOSUB 4100: GOTO 1040
1150 IF CH$="C" THEN GOSUB 5000: GOTO 1000
```



```

1160 IF CH#="S" THEN GOSUB 5500: GOTO 1000
1170 IF CH#="L" THEN GOSUB 5750: GOTO 1000
1180 IF CH#="W" THEN GOSUB 6000: GOTO 1000
1190 GOTO 1050
1195 :
2000 REM ** DISPLAY TEXT **
2010 IF TP=TS THEN RETURN
2020 DF=DSRT+800
2030 IF DF<TP THEN 2070
2035 :
2040 DF=TP
2050 S=DF: F=DS+800: D=S+1
2060 POKE S, 32: GOSUB 9350
2065 :
2070 S=DS: F=DS+800: D=H00E
2080 GOSUB 9350: RETURN
2085 :
2500 REM ** INSERT **
2510 PRINT "INSERTING " CH#
2520 IF CP=MID THEN DS=DS+(CP-MID): CP=MID
2530 SD=120
2540 ES=DP: S=TP: F=DP: D=TP+SD
2550 GOSUB 9300: TP=D
2555 :
2560 POKE DP, 32
2570 S=DP: F=DP+SD-1: D=DP+1
2580 GOSUB 9350: GOSUB 2000
2585 :
2600 GOSUB 9000: GOSUB 9100
2610 IF CH=13 THEN 2750
2620 IF CH=20 THEN 2600
2630 IF CC THEN 2600
2635 :
2650 CH=(CH AND 63) OR (CH AND 128)/2
2660 IF DF=(ES+SD-1) THEN 2650
2665 :
2700 POKE CP, CH: CP=CP+1
2710 POKE DP, CH: DP=DP+1
2720 GOTO 2600
2725 :
2750 S=ES+120: F=TP: D=DF
2760 GOSUB 9350: TP=F-(S-D)
2770 RETURN
2775 :
2800 DF=DF-1: POKE DP, 32
2810 CP=CP-1: POKE CP, 32
2820 GOTO 2600
2825 :
2850 POKE CP, CH: CP=CP+1
2860 POKE DP, CH: DP=DP+1
2870 GOTO 2500
2875 :
3000 REM ** DELETE **
3010 PRINT "DELETING ■ CURSOR CONTROLS: C=ENTER ■:SP:SP"
3020 GOSUB 2000: EF=DF
3025 :
3100 DTEMP=DF
3110 GOSUB 9000: GOSUB 9100
3120 IF CH=13 THEN 3400
3130 IF CH=ES THEN CP=CP+ES: DP=DP+ES
3140 ON SIGN(DP-DT)+2 GOTO 3200,3110,3300
3145 :
3200 FOR P=DTEMP TO DP STEP -1
3210 POKE P, FEEL(P) AND 127: NEXT
3220 GOSUB 2000: GOTO 3100
3225 :
3300 IF DT=DF+1 THEN 3110
3305 FOR P=DTEMP TO DP-1
3310 POKE P, FEEL(P) XOR 28: NEXT
3320 GOSUB 2000: GOTO 3100
3325 :
3400 REM ** COPY UP **
3410 CP=DF-ES
3420 S=DF-1: F=ES: D=TF
3430 GOSUB 9300
3435 :
3440 S=DP: F=TP: D=ES
3450 GOSUB 9350: SD=S-D
3460 CP=CP-SD: DP=DP-SD: TP=TP-SD
3465 :
3470 IF ES=DS THEN RETURN
3480 GOSUB 4300: GOTO 3470
3485 :
3500 REM ** EXCHANGE **
3510 PRINT "EXCHANGING " CH#
3515 :
3600 GOSUB 9000: GOSUB 9100
3610 IF CH=13 THEN RETURN
3620 IF CH=20 THEN 3800
3630 IF CC=TRUE THEN 3600
3635 :
3700 CH=(CH AND 63) OR (CH AND 128)/2
3710 POKE CP, CH: CP=CP+1
3720 POKE DP, CH: DP=DP+1
3730 GOTO 3600
3735 :
3800 DP=DP-1: POKE DP, 32
3810 CP=CP-1: POKE CP, 32
3820 GOTO 3600
3825 :
4000 REM ** NEXT PAGE **
4010 IF DF=TF THEN RETURN
4020 FOR N=1 TO 10: GOSUB 4500: GOSUB 4500
4030 GOSUB 2000: NEXT
4040 RETURN
4045 :
4100 REM ** PREVIOUS PAGE **
4110 IF DS=TS THEN RETURN
4120 FOR N=1 TO 10: GOSUB 4600: GOSUB 4600
4130 GOSUB 2000: NEXT
4140 RETURN
4145 :
4200 REM ** SCROLL UP **
4210 GOSUB 4500: GOSUB 2000
4220 CP=CP+40: DP=DP+40: RETURN
4225 :
4300 REM ** SCROLL DOWN **
4310 GOSUB 4600: GOSUB 2000
4320 CP=CP+40: DP=DP+40: RETURN
4325 :
4500 REM ** MOVE UP **
4510 IF (DS+40)>TP THEN RETURN
4520 DS=DS+40: DP=DP+40
4530 RETURN
4535 :
4600 REM ** MOVE DOWN **

```

```

4610 IF (DS+40)>TS THEN 4700
4620 DS=DS+40: DP=DP+40
4630 RETURN
4635 :
4700 DP=DP-(DS-TS)+DS=TS
4710 RETURN
4715 :
5000 REM ** COPY DOWN **
5010 SETP=F: DP=D: TP=D
5020 GOSUB 9300: TP=D
5025 :
5030 SETP=CP+1: F=TP+1: D=DP
5040 GOSUB 9350
5050 RETURN
5055 :
5500 REM ** DISC SAVE **
5510 OPEN 15:8:15
5520 INPUT "DISC DRIVE #:" D#
5530 INPUT "FILE NAME:" F#
5540 OPEN 2:8:2: D#+"F#"+".S.W"
5550 GOSUB 5900
5555 :
5560 PRINT #2: TP-TS: CHR$(13):
5570 GOSUB 5900
5575 :
5580 FOR N=TS TO TP-1
5590 CH=PEEK(N): PRINT #2: CH#; CH#;
5600 NEXT
5610 CLOSE #2: CLOSE #1: RETURN
5615 :
5750 REM ** DISC LOAD **
5760 OPEN 15:8:15
5770 INPUT "DISC DRIVE #:" D#
5780 INPUT "FILE NAME:" F#
5790 OPEN 2:8:2: D#+"F#"+".S.W"
5800 GOSUB 5900
5805 :
5810 INPUT #2: N: TP=TS+N
5820 GOSUB 5900
5825 :
5830 FOR N=TS TO TP-1
5840 GET #2: CH#; POKE N, ASC(CH#)
5850 NEXT
5860 CLOSE #2: CLOSE #1: RETURN
5865 :
5900 REM -READ ERROR (HARDWARE)
5910 INPUT #1: EN#; EN#; ET1; ES1
5920 IF EN#="00" THEN RETURN
5930 PRINT "EN#; EN#; ET1; ES1"
5940 CLOSE #2: CLOSE #1: RETURN
5945 :
6000 REM ** WRITE **
6010 PRINT "WRITE TO SCREEN OR PRINTER. S=00":
6020 INPUT FL#; FL#; LEFT$(FL#), L#
6025 :
6030 REM -DEFAULT PARAMETERS-
6040 IF FL#="S" THEN FL=3: FW=40: FH=20: LMAFG=1: RMAFG=3
6050 IF FL#="P" THEN FL=4: FW=80: FH=60: LMAFG=5: RMAFG=7
6060 TL=INT(.10*FH)
6070 BL=INT(.90*FH)
6075 :
6100 REM -VERIFY FORMAT-
6110 PRINT "JUSTIFIED: Y=000":
6120 INPUT JU#; JU#; LEFT$(JU#), J#
6130 PRINT "PAGE NUMBER: 0000":
6140 INPUT PN#
6150 PRINT "LEFT MARGIN: " LM#
6160 INPUT "LM#": LM#
6170 PRINT "RIGHT MARGIN: " RM#
6180 INPUT "RM#": RM#
6190 PRINT "DOUBLE SPACED: N=000":
6195 INPUT DS#; DS#; LEFT$(DS#), D#
6200 :
6210 IF FL=D# THEN 6300
6220 PRINT "PLEASE CHECK -"
6230 PRINT "CHECK POWER AND PAPER"
6235 :
6240 PRINT "TYPE ANY KEY WHEN READY"
6250 GET CH#; IF CH#="" THEN 6250
6260 PRINT "OK"
6265 :
6300 REM ** PRINT TEXT **
6310 :
6350 REM -INITIALISE TEXT-
6360 XT=FALSE: POKE TP, 32
6370 CNTR=FALSE: DELE=FALSE: WAF=FALSE
6380 LP=DP: OPEN 1: FL
6385 :
6400 REM -PRINT PAGES-
6410 GOSUB 6500
6420 PRINT "PRESS C TO CONT. OR F TO FINISH"
6430 GET CH#; IF CH#="" THEN 6430
6440 PRINT "SF#""
6450 IF CH#="C" AND XT=FALSE THEN 6410
6455 :
6460 REM -CLOSE TEXT-
6470 CLOSE 1
6480 RETURN
6485 :
6500 REM ** PRINT PAGE **
6510 :
6550 REM -INITIALISE PAGE-
6560 XP=FALSE: LN#1: NL#0: SL#1
6565 :
6600 REM -PRINT HEADER-
6610 PRINT #1: LN#LN+1
6620 IF LN#TL THEN 6610
6625 :
6650 REM -PRINT LINES-
6660 IF DS#="" THEN PRINT #1: LN#LN+1
6670 GOSUB 6800
6680 IF XP=FALSE THEN 6660
6685 :
6700 REM -PRINT FOOTER-
6710 PRINT #1: LN#LN+1
6720 IF LN#BL THEN 6710
6730 IF PN#0 THEN 6760
6735 :
6740 PN#="" + STR$(PN#) + " " + PN# + PN# + 1
6750 PRINT #1: SP0 (PW-LN#(PN#)/2): PN#
6755 :
6760 PRINT #1: LN#LN+1: IF LN#FH THEN 6760
6770 RETURN
6775 :
6800 REM ** PRINT LINE **

```

GOTO page 168

The new flexible multi-user system

The Vector Graphic 5005

from Almarc

with 5 megabyte Winchester, 630k floppy disc

The new Vector 5005 is a multiple-user, multi-tasking hard disc system for general business and word processing applications.

It is a low priced system with highly rated capabilities.

It supports up to a maximum of 5 users and gives 5 megabytes of high-speed totally reliable Winchester disc technology with Vector's automatic error correction feature. It is also MP/M compatible.

Total flexibility means that the VG 5005's terminals can work independently which permits the widest possible range of usage. One user could use Execuplan for financial planning whilst the second user is entering sales information with accounting software and the third may run correspondence simultaneously with Vector's Memorite III word processing software. Each user gets a full 56k bytes of RAM and most other standard CP/M

compatible applications software will run on the system e.g.

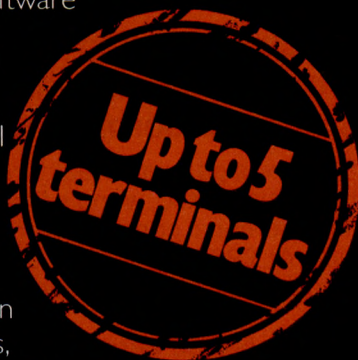
COBOL, FORTRAN, PASCAL, BASIC COMPILER, ALGOL, PL/I and other statistical and data based management packages.

The Vector Graphic 5005 is ideal for application packages, such as accounts, stock control, payroll, word processing, financial modelling and solicitors packages, all available from Almarc.

For further information on the VG 5005 write or telephone Almarc. Complete sales and servicing facilities are available throughout the U.K.

Almarc Data Systems Ltd.,
906 Woodborough Road,
Nottingham NG3 5QS.
Tel: (0602) 625035.
Telex: 37407 Almarc/G.

Also at:
Green Street,
High Wycombe,
Bucks. HP11 2RF.
Tel: (0494) 23804.



Almarc

DATA SYSTEMS




```

30 FOR I=1
35 LET P=R
37 PRINT P
40 LET A(I)
50 NEXT I
54 PRINT
55 PRINT
56 PRINT "I
57 PRINT
60 LET D=0
70 FOR I=0
80 LET T(I)
90 NEXT I
100 FOR I=1
110 LET X=A
120 LET N=X
130 IF T(N)
THEN GO TO 2
140 IF T(N)
150 LET T(N)

```

Reach advanced computer comprehension in a few absorbing hours

Over 50,000 were sold, and the ZX80 won virtually universal praise from computer professionals.

Now the Sinclair lead is increased: for just £69.95, the new Sinclair ZX81 offers even more advanced computer facilities at an even lower price. And the ZX81 kit means an even bigger saving. At £49.95 it costs almost 40% less than the ZX80 kit!

With the ZX81, it's just as simple to teach yourself computing, but the ZX81 packs even greater working capability than the ZX80.

It uses the same micro-processor, but incorporates a new, more powerful 8K BASIC ROM – the 'trained intelligence' of the computer. This chip works in decimals, handles logs and trig, allows you to plot graphs, and builds up animated displays.

And the ZX81 incorporates other operation refinements – the facility to load and save named programs on cassette, for example, or to select a program off a cassette through the keyboard.

Quite simply, by design. The ZX80 reduced the chips in a working computer from 40 or so, to 21. The ZX81 reduces the 21 to 4!

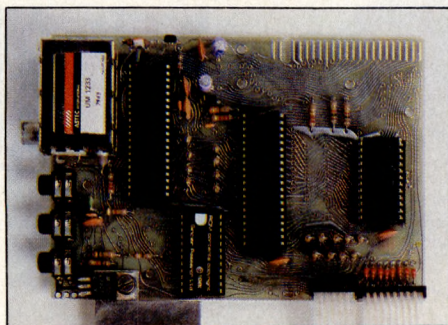
The secret lies in a totally new master chip. Designed by Sinclair and custom-built in Britain, this unique chip replaces 18 chips from the ZX80!

Built:
£69.⁹⁵
complete

**Kit
or built –
it's up to you!**

The picture shows dramatically how easy the ZX81 kit is to build: just four chips to assemble (plus, of course the other discrete components) – a few hours' work with a fine-tipped soldering iron. And you may already have a suitable mains adaptor – 600 mA at 9 V DC nominal unregulated (supplied with built version).

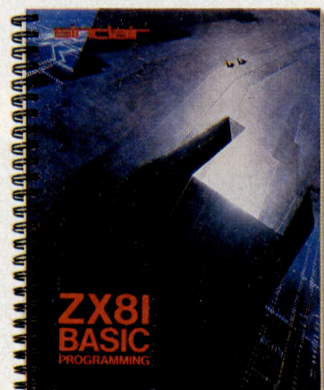
Kit and built versions come complete with all leads to connect to your TV (colour or black and white) and cassette recorder.



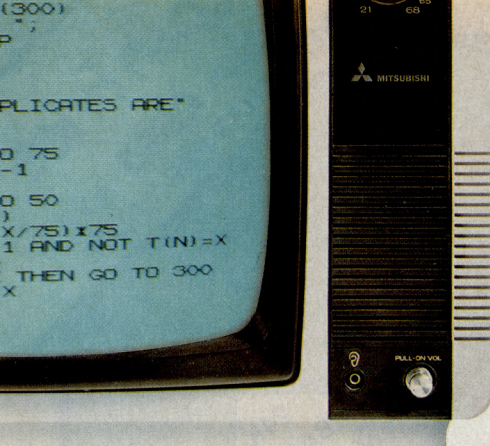
Proven micro-processor, new 8K BASIC ROM, RAM—and unique new master chip.



New BASIC manual



Every ZX81 comes with a comprehensive, specially-written manual – a complete course in BASIC programming, from first principles to complex programs.



If you own a Sinclair ZX80...

The new 8K BASIC ROM used in the Sinclair ZX81 is available to ZX80 owners as a drop-in replacement chip. (Complete with new keyboard template and operating manual.)

With the exception of animated graphics, all the advanced features of the ZX81 are now available on your ZX80 – including the ability to drive the Sinclair ZX Printer.

Coming soon – the ZX Printer.

Designed exclusively for use with the ZX81 (and ZX80 with 8K BASIC ROM), the printer offers full alpha-numerics across 32 columns, and highly sophisticated graphics. Special features include COPY, which prints out exactly what is on the whole TV screen without the need for further instructions. The ZX Printer will be available in Summer 1981, at around £50 – watch this space!



16K-BYTE RAM pack for massive add-on memory.

Designed as a complete module to fit your Sinclair ZX80 or ZX81, the RAM pack simply plugs into the existing expansion port at the rear of the computer to multiply your data/program storage by 16!

Use it for long and complex programs or as a personal database. Yet it costs as little as half the price of competitive additional memory.



How to order your ZX81

BY PHONE – Access or Barclaycard holders can call 01-200 0200 for personal attention 24 hours a day, every day. BY FREEPOST – use the no-stamp-needed coupon below. You can pay by cheque, postal order, Access or Barclaycard. EITHER WAY – please allow up to 28 days for delivery. And there's a 14-day money-back option, of course. We want you to be satisfied beyond doubt – and we have no doubt that you will be.

New, improved specification

- Z80 A micro-processor – new faster version of the famous Z80 chip, widely recognised as the best ever made.
- Unique 'one-touch' key word entry: the ZX81 eliminates a great deal of tiresome typing. Key words (RUN, LIST, PRINT, etc.) have their own single-key entry.
- Unique syntax-check and report codes identify programming errors immediately.
- Full range of mathematical and scientific functions accurate to eight decimal places.
- Graph-drawing and animated display facilities.
- Multi-dimensional string and numerical arrays.
- Up to 26 FOR/NEXT loops.
- Randomise function – useful for games as well as serious applications.
- Cassette LOAD and SAVE with named programs.
- 1K-byte RAM expandable to 16K bytes with Sinclair RAM pack.
- Able to drive the new Sinclair printer (not available yet – but coming soon!)
- Advanced 4-chip design: micro-processor, ROM, RAM, plus master chip – unique, custom-built chip replacing 18 ZX80 chips.

Sinclair ZX81

Sinclair Research Ltd,
6 Kings Parade, Cambridge, Cambs.,
CB2 1SN. Tel: 0276 66104.
Reg. no: 214 4630 00.

To: Sinclair Research Ltd, FREEPOST 7, Cambridge, CB2 1YY.

Order

Qty	Item	Code	Item price £	Total £
	Sinclair ZX81 Personal Computer kit(s). Price includes ZX81 BASIC manual, excludes mains adaptor.	12	49.95	
	Ready-assembled Sinclair ZX81 Personal Computer(s). Price includes ZX81 BASIC manual and mains adaptor.	11	69.95	
	Mains Adaptor(s) (600 mA at 9 V DC nominal unregulated).	10	8.95	
	16K-BYTE RAM pack(s).	18	49.95	
	8K BASIC ROM to fit ZX80.	17	19.95	
	Post and Packing.			2.95

Please tick if you require a VAT receipt ☐

TOTAL £

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*Please charge to my Access/Barclaycard/Trustcard account no.

*Please delete/complete as applicable.

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PCW09

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NAME _____

ADDRESS _____

MY INTEREST IS: _____

SELF-SUFFICIENCY

Spastics run Apple business

Tony Williams reports on an Apple dealership with a difference.

PCW readers (children's TV fans all!) will doubtless be aware that as part of the International Year of the Disabled, 'Blue Peter' has raised enough funds from young viewers to provide eight microcomputers for the Spastic Society. In mid-May these complete Apple systems were officially purchased and handed over to the Spastic Schools where sufferers from cerebral palsy (roughly speaking, brain damage from birth) will use them for improved communications with the outside world.

But discerning readers will also be asking about the back-up service, about software provision and about technical maintenance, for want of which these glamorous machines could share the fate of so much other fancy equipment, such as the language labs, installed in schools in the 'sixties rush, now unmaintained, forgotten and gathering dust in storerooms. That sad lesson has not been lost on the Spastic Society, however, and it has come up with its own home-grown solution, the Neath Hill Professional Workshop, a scheme from which only winners will emerge.

With this in mind I went along to the Spastic Society's Workshop in Milton Keynes on the day that the project co-ordinator, Peter Deakin, was away arranging an initiation course for end users of the Blue Peter Apples.

Speaking to its secretary, Sheila Walters, I learned that the Workshop sets its sights far higher than mere provision of technical maintenance for machines out in the schools. It is, in fact, a unique experiment in economic self-sufficiency for the highly intelligent but severely disabled, unthinkable before the microcomputer became widely available. It has long been recognised that apart from other valuable functions, computers come into their own in opening up new channels of communications for the handicapped. The micro, however, has brought the computer within range of those who have no chance of gaining access to a mainframe.

As Sheila put it, 'What would they do without a computer? I don't mean programmers, I'm talking about people who would like to run a business but simply cannot pick up a pen or a piece of paper. These are the people that can use the computer as a tool. Our original idea was for people to be able to come here and do their own thing, whether it is to set up as solicitors or accountants but for which they need some form of physical help. It would cost a fortune to provide everyone with a personal secretary but a micro for all is attainable.'

When fully manned, the Neath Hill

Professional Workshop — a neat one-storey brick structure of administrative offices and workrooms grouped around a glass-roofed quadrangle — will have room for 12 employees. In its short lifespan — it went operational only in the autumn of 1980 — it has taken on ten employees including two programmers and a technician as well as people in marketing and administration. Four of the administrative personnel are able-bodied.

From the start, the guiding philosophy has been emphasis on self-reliance and economic viability and it is this that has caught the imagination of disabled but ambitious people throughout the



country. There is fierce competition to get to Neath Hill and the Spastic Society carries out a rigorous selection procedure to ensure that its investment in training will pay off. Once accepted at the Workshop, however, these formerly institutionalised disabled people are treated as equal partners and are expected to make an economically useful contribution to the collective. If things go according to plan, the unit will be free of subsidy in the foreseeable future.

Despite the outside support and training elements present in the Workshop project, Sheila Walters was at pains to point out that 'Our business is business.'

The first logical step for the unit was to take over an Apple dealership. The lengthy procedure of establishing this, scraping together the bare minimum of capital, satisfying the technical back-up requirements stipulated by Microsense (the official Apple importer), etc, fortunately came to a successful end just as 'Blue Peter' finally dispensed its Appeal funds. And so Neath Hill was able to pick up that piece of business. Not all the business is in-house, of course, and other hard-eyed purchasers in the Milton Keynes vicinity are already finding their way out to Neath Hill to be given the Apple sales pitch.

For the moment, point of contact

sales and administration are mostly being performed by able bodied members of the staff and technical maintenance is also being performed by an outside able-bodied person. But in the next few months the handicapped partners will be more involved here. In a way the dealership is a chance but lucrative afterthought and the central core of the project is the writing and development of bespoke business software. This side of the operation is already firmly in the hands of the disabled partners.

Eventually, the unit will need four programmers, four people working on the development project at the Cranfield Institute of Technology and two on the marketing side.

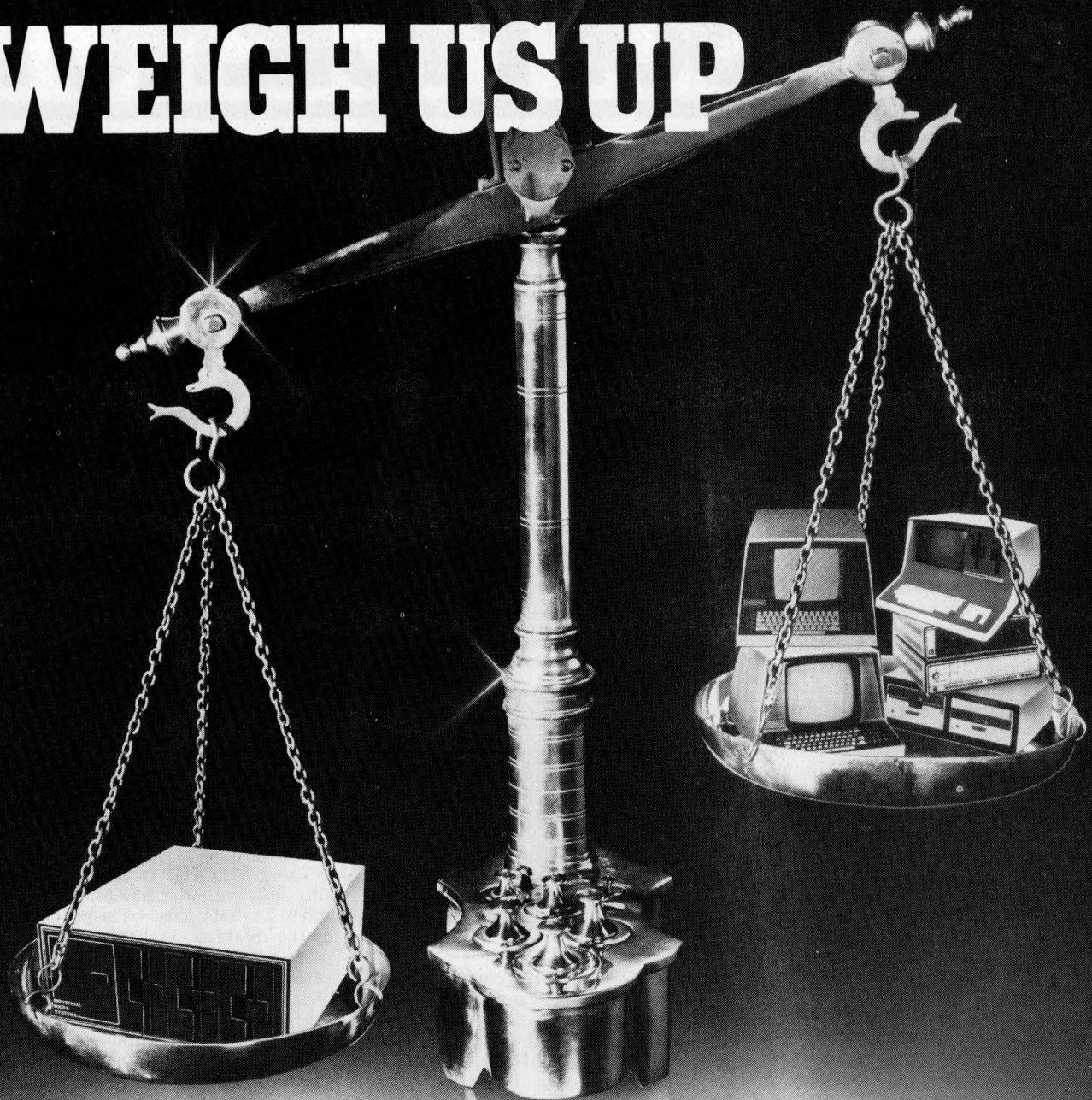
Cerebral palsy inhibits proper control of bodily functions and movements but it does come in varying degrees of severity. David Edwards, for instance, who is on the marketing side, can walk, get on a bus alone, lives outside and is married with a child. Others are wheelchair bound.

The Neath Hill workshop has been built in a new residential estate in which 24 flats have been purpose-built for the disabled; 12 have been allocated to the workshop. Each flat has an alarm system to summon help if needed. Living in a central staff house is a duty care staff team of full-timers, police cadets and community service volunteers. These volunteers help the disabled to get out of bed and whatever else is needed but do not normally see them again until they come home from work. The Workshop is just what it claims to be, a place where the disabled go to work and is not a 'Home' or institution.

As Sheila Walters put it, the Workshop has naturally attracted a great deal of favourable publicity within the society and outside and its combination of respect for human dignity, good humoured mucking-in and cold economic calculation has made it the object of fierce competition from would-be partners.

The criteria for admission are very strict. Everybody must have a degree or an IQ of at least 120. Anyone who hears about the Workshop and wants to come must apply to Head Office. Someone visits them at their Home — they are mostly in Homes — and usually Peter Deakin visits them as well; then they are assessed on what they can do and what they have done already. The next stage is for them to apply to their local authority for sponsorship to cover their housing expenses. If that comes through they are taken to the Spastic Society hostel in Birmingham where they stay

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for a period of weeks for assessment of their physical needs, how far they are able to fend for themselves and also for their intellectual capabilities. Back at Head Office, an Assessment Board sits and examines all the various reports and makes the decision on whether they can go ahead. It's a long, drawn-out process. The most distressing thing is when somebody is rejected. One man was turned down but since then he has mounted a relentless campaign to get here by hook or by crook. He might yet make it by sheer dogged persistence.

'As this is absolutely the first workshop of its kind in the world, we are very much in the public eye. We have to tread gingerly and are always conscious that we have got to get it right.'

After Sheila Walters' briefing, I went into the open plan area where the programmers were working at their keyboards. I talked to them about what they were doing and about their lives before coming to Neath Hill.

To key in programs when you haven't got precise control of your limbs or voice, you use your chin, your feet, elbows, a pencil gripped between the toes — anything you've got that seems more or less controllable at the time. The pace is agonizingly slow and the mistakes many — which makes these programmers only marginally less effective than all other programmers I know (two-finger peckers all, equally given to stabbing wildly at a keyboard with a pencil). In this sense the micro is the great leveller — it enables the severely disabled to function on approximately the same level as the able-bodied. What counts is getting the logic right and not having nimble fingers.

At this point, I must confess that I went along to visit the workshop with a certain pre-formed assumption that because of their keying-in difficulties, these mental giants would school themselves to assemble in their heads perfectly structured algorithms before going near the keyboard. They soon disabused me of that idea and I am relieved to report that they let themselves get suckered into the same old Basic trial-and-error traps as the rest of us.

I spoke first to Glynn Vernon, who is wheelchair bound, has severe speech difficulties but can make himself tolerably well understood. He has limited use of one arm for keying in and when the going gets rough he can give his answers using Applewriter. After taking his degree in social sciences, Glynn did a 12 week government TOPS course in Cobol at Queen Elizabeth Training College, Leatherhead, working on an ICL machine. His first acquaintance with Basic was on coming to Neath Hill at Christmas, 1980. Since then he has been working on a mailing list for the Toy Libraries Association. He had to start from scratch on this project because of their specific requirements, including sorting on 24 different fields. This project is nearing completion and a generally applicable version is to be marketed.

These business utilities are just a start for Glynn, however, and as he gets more proficient he hopes to be able to apply his programming expertise in his own field — social sciences. He is also working on a demo program to be

shown at the House of Commons shortly in connection with the Year of the Handicapped. Glynn explained: 'There is a world of difference between the means of communication I was using two or three years ago and the computer. Those old devices were all right in their way and I wouldn't want to knock them, but the computer is something else again. This is not just a way of talking, it is a way of doing!'

Barefoot Maria Brookes prefers to use a pencil between her toes to debug her own 'Maria's Computi-Dateline' which is not quite what it sounds like. What she has in mind is a kind of question and answer session for couples who are already together at which they would check up point by



point on whether they are really compatible. If the points stack up the wrong way, the computer would tell them to split up! Maria has applied to come to Neath Hill as a partner, but so far is only able to pop in as a visitor since she lives in the area. She has a PET at home but finds the Apple more versatile and challenging, so is eager to look in and practice occasionally. Maria is hoping to start up a computer dating register for handicapped people like herself, matching up desires, types of handicap and availability. She plans to be her own first customer.

Maria uses only Basic to program in, which she learned first at school on a Newbury. 'I had a lot of trouble with my O Level in computer science. The other subjects I could answer by dictating to a friend — it went slowly and I was allowed an extra hour for that. But in computer science the trouble was I couldn't do the flowcharts physically — and they were obligatory. I fought a long battle with the examining board beforehand. I had a friend who had convinced his own examiners that a thing called KDL would do just as well — Keyboard Design Language I think it was called — and I learned how to use it but my Board turned that down, too. So I was stuck with my flowcharts again. In the end my own teacher was invigilating and he saw to it that I managed. It's still a problem, though.'

A vital factor for the commercial success of the dealership venture will be its ability to service the micros up to Apple requirements. For the moment they can call upon the services of an outside able bodied engineer, but eventually the unit will have to be self-sufficient — and this is where Colin comes in.

After taking his City and Guilds examination in TV and Radio engineering up in Humberside, Colin Cox came down to Neath Hill to see how he makes out with computer

electronics, which he regards as a rather daunting challenge. 'I have had to re-vamp all my ideas to fit into the Apple way of thinking — or computer electronics in general, come to think of it. I can't tell you how I am making out as a technician yet — come back in a few months then ask me again. I hope I'll be able to do a real servicing job as well as do some designing for the modifications we think useful for handicapped people. It is up to disabled people like me to show the world that we are worth something as individuals and can find a proper place in the world.'

Dick Boydell, one of the most severely disabled programmers, uses his feet — by slipping one foot into a special clog equipped with a sharp claw for depressing the Control key, and using one toe on the other for keying-in work. Hitting Control C; Return is a trial by ordeal for all handicapped programmers, not to speak of Control-Shift-M! (Hardware solutions to this problem are on the drawing boards at Neath Hill and elsewhere but for the time being they all get by with completely unmodified Apples.) None of the programmers I spoke to could manage to put their own disks in. When he starts a session Dick asks an able-bodied person to feed the disks he has chosen into his four disk drives. Dick has a long and highly successful career of academic study behind him but switched to computing while at Oakwood in Essex. There he worked for Ford, doing Cobol programs (on a typewriter!) which were then collected up and transferred by others onto a mainframe. Since coming to Neath Hill he has been working on a stock control program for a Work Centre for the Disabled. All the stock control software to be used by the Spastic Schools throughout the country will eventually come from Dick's clog and able toes.

It would be wrong to give the impression that because they have an economically viable future, the partners in the Neath Hill scheme can get along independently — they need massive care from able-bodied helpers, the small administrative staff, secretaries. And this, in a paradoxical way could be the long-term guarantee of success for the team. The down-to-earth struggle for physical survival from hour to hour is so great that the only tenable attitude on the part of the able-bodied staff is one of good humoured, unsentimental dedication and total participation. No room for secretarial prima donnas here! Marie Gibb, who does the driving, also doubles as Dick's best interpreter. Everyone pitches in and helps at the long extended mealtimes (If you hit a wrong key you can erase it, but if you miss your mouth you're in the soup!)

All that is missing so far is some excruciating Apple pun to name this dealership by. The idea of 'The DOS House' was tossed around during the dinner table banter but rejected as not really appalling enough to live up to the tradition.

Sheila: 'There's no doubt about it — the Workshop has opened up a new lease of life for our people here. Some of them have been stuck in institutions for years so just think what it means to them to come out where they have to exercise their minds.'

PRINTERFACING EXTRA

Peter Faff replies to a reader's query arising from his recent series.

I was interested in Peter Faff's article in the May issue concerning the interfacing of calculators with micros, and I feel that you should warn your readers not to spend any considerable sum on a calculator without some fairly careful investigation.

Some years ago I wished to interface a calculator to hard wired CMOS logic, and I tried to do this exactly in the manner described in the article.

I successfully deciphered the matrixed keyboard by tracing the tracks on the keyboard PCB, and built a logic board interface using CMOS 4016 switches, these being effectively equivalent to the 4066 quoted in your article.

As soon as I plugged the calculator into the logic board, the keyboard locked up solid and would not accept data from the logic or from the keyboard. After much midnight oil and head-scratching, I borrowed an oscilloscope and found that, although the calculator ran off a 9V battery, the keyboard was switching multiplexed pulses at -27V. There is an absolute prohibition on the 4016 against switching voltages outside the supply voltage, and they were therefore looking like a dead short to the keyboard.

After finding this out, I rebuilt the board using reed relays, but then found that these seemed to be somehow disabling the anti-bounce circuitry on the keyboard and I was getting several entries per digit input, thus the first digit to be entered (I wished to enter a four-figure number) was filling up the display. Although I was able to establish that the logic was working correctly, I never did get the interface to work. I think it likely that solid state switching may possibly operate successfully, but I didn't have sufficient confidence in my electronic ability to design this, and I eventually abandoned the project.

K P Wood, Wakefield

I am indebted to Mr Wood for raising a few points concerning my 'Printerfacing Plus' article that I did not clarify too well. I hope that the following notes will be of some use to Mr Wood and also that they prevent anyone else from making the same mistakes.

Mr Wood had assumed that the KBD strobe signals would be equal to the battery voltage, ie, 9 volts, which is not always the case, as he discovered. When attempting to interface to this type of equipment you should never take anything for granted. If you beg, steal or

borrow a 'scope so that you can see what is going on you will find life so much easier. Mr Wood does not state what type of calculator he was using but I should imagine that it had a blue/green type of fluorescent display. These displays are found on many calculators because they consume less power than LEDs. They generally operate from a negative supply in the range of 20 - 36 volts. This high (?) voltage is produced by a DC to DC convertor circuit and so the battery will give you no clue as to what voltages may lurk within the calculator. This is where a 'scope comes in useful.

For reasons of cost (ie, it's cheaper) most modern fluorescent display calculators use a chip that drives the display directly. In some cases the digit enable signals are also used to strobe the keyboard matrix. This normally means that the KBD strobe signals are too large to be switched by CMOS, as Mr Wood found out. This problem should only occur with fluorescent display calculators but it is wise to check first. If your calculator uses an LED or LCD display, there should not be any problem with the KBD signals. For example my aged Texas Instruments SR50A has KBD scan pulses of 10 volt magnitude while my trusty Casio fxb02p has 3V KBD scan pulses; both these could be handled by CMOS electronic switches.

After this impasse, Mr Wood rebuilt his interface using reed relays but again he had problems. Every time that a reed was operated it entered the digit onto the display several times where only one entry was intended. This problem was caused by contact bounce, which reed relays are renowned for. If you use reed relays you may have problems, then again you may not. This is because the time delay built into the chip for switch debouncing varies from calculator to calculator. The only way to find out if reed relays will be any good is to try them and see. Then again, some old calculators already use reed relays and magnets in the keyboard so you should not have any problem with this type of machine. This is fine but most modern calculators use keyswitches, snap switches or conductive elastomer contacts which do not suffer very much from contact bounce unless they are dirty.

If your keyboard scan signals are too high for CMOS to handle and if the switch debounce time is too short for

reed relays to be of any use, you will have to think about using a different type of electronic switch. Transistors, Triacs and Fets should all be suitable provided that a little ingenuity is used in the design of the switching circuit. An alternative would be to level-shift the keyboard strobe signals down to a sensible voltage; the resultant pulses can now be switched by standard logic gates which then drive a circuit to switch the IC inputs between the correct levels; see Figure 1. A ULN 200 1/2/3/4 darlington driver array should also be suitable. This method should work provided the circuit does not introduce too large a time delay.

That covers most of the problems that you may come across. The only other point worth noting is that connections between calculator keyboard and the interface board should be kept short to prevent problems being caused by crosstalk between the lines.

Another point worth noting is that some printing calculators have two-key roll-over so that you can press one key then another, and then when the first key is released the second key will also be entered onto the display. If your machine does this, you can speed up data entry into the machine because you don't have to leave a pause between key operations; instead you can operate the keys directly one after the other.

The display interface should not cause too many problems. In my article I suggested a circuit that selected a digit position and then read out the displayed data for that position. An alternative would be for the interface circuit to encode the data for each digit as it is displayed, and then to output this data while at the same time operating a flag and telling the micro which digit is being displayed at that moment. I did mention last time that you should stay away from liquid crystal displays if you value your sanity.

Unfortunately from an interfacing point of view, LCD displays seem to be the in thing at the moment, so if I pluck up courage I may operate on my faithful Casio in order to devise a circuit for getting meaningful electronic information out of a multiplexed LCD displays. I'll let you know if I succeed!

Finally, I can only stress again that if you are going to attempt any interfacing of this nature then you must have access to a scope since it will make life so much easier.

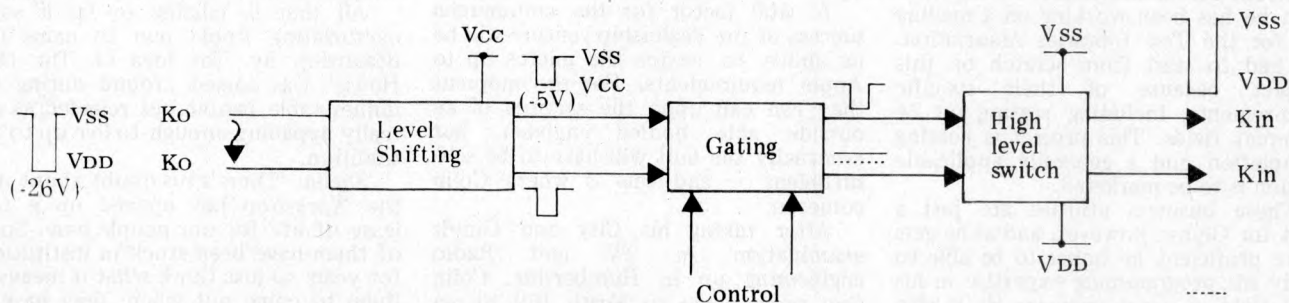


Fig. 1

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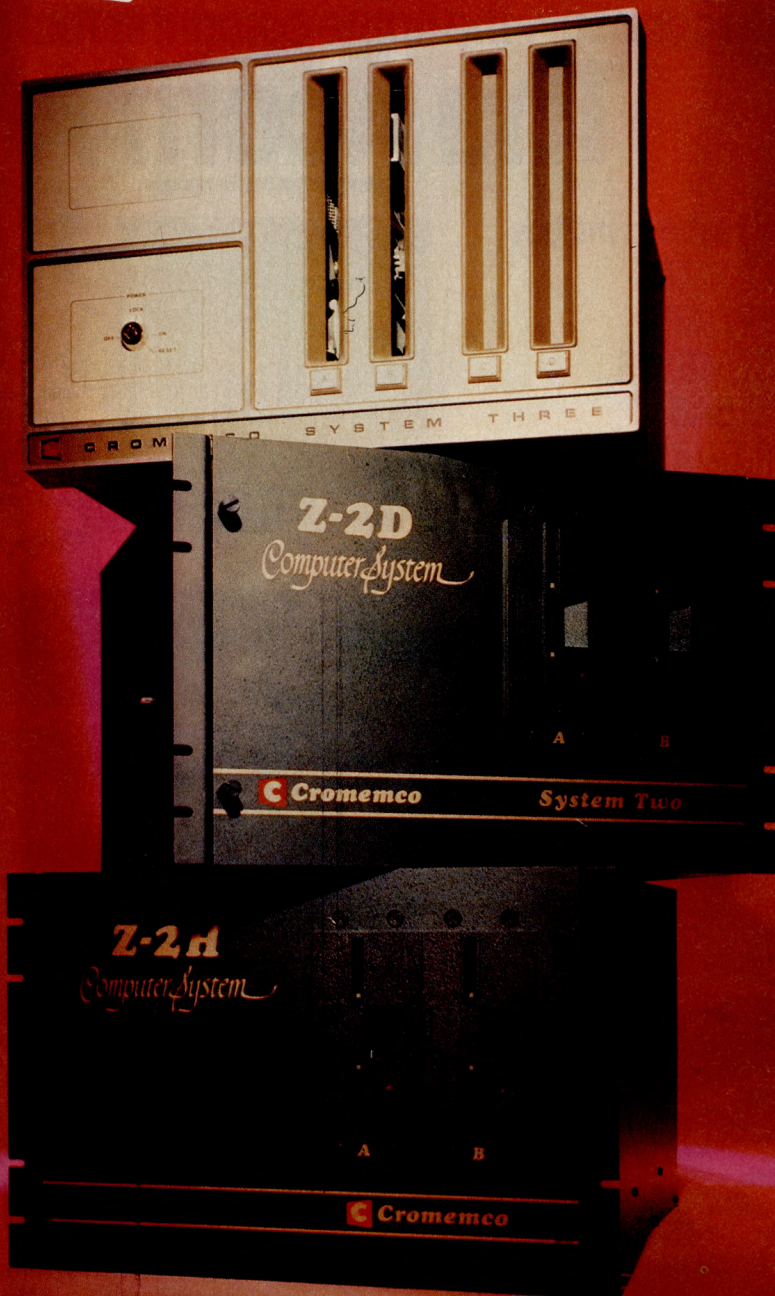
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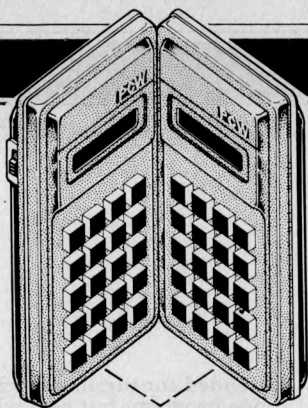
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CALCULATOR CORNER

Dick Pountain conducts a mini-Benchmark on Casio's latest offering — the fx602p

502+256=602

Due to the kindness of Tempus of Cambridge in lending me a sample model, I am able to offer a review of the new Casio fx-602p alphanumeric programmable calculator a couple of months sooner than I had expected.

My first reaction on unpacking the machine was: 'Surely some mistake, this is a 502p.' The external similarity is so close that you have to look twice to make sure it says fx-602p at the top. A second look reveals some differences: the on-off switch is at top right, not top left; the overall colour is pale gold/bronze, not silver/brown; and the display, though of identical size, is grey, not yellow and has the legend 'lithium' written in the corner. The dimensions of the case are identical, a necessary move since it is to fit into the same FA-1 cassette interface adaptor as the 501/502p. The keyboard is identical in layout, a smart move as it saves on retooling; each key, however, has an extra legend printed below it in green comprising a 43 character alphanumeric set. Even the brown plastic wallet is the same as the older model's.

On switching on the difference becomes more real; the ten character LCD display is based around a 5 x 7 dot matrix and uses a computer style crossed zero (0). The figures are large and legible and the usual annunciator is present for the different operating modes, angular modes and current status, with the addition of an extra one for ALPHA mode. The two-digit exponent is displayed at stage right using the old style seven segment display which is more readable for small figures.

Two lithium batteries are used which, though larger than the 502's mercury cells, are rated 660 hours, half the life of the latter. This is because the fancy display and extra CMOS memory draw more power than of old. Automatic power off occurs after six minutes of disuse.

Functions

The 602p has exactly the same function set as the 502p with one addition: an extra FIX format for truncating decimals. FIXn displays a decimal fraction rounded to n decimal places. The RND function of the 502p rounds to n significant figures in scientific notation. Neither function truncates the internally held value, merely the displayed value.

All other functions are identical, even to being assigned the same keys; this includes the program instructions and ten program registers as well as maths.

Memory

One of the two major differences from the 502 is that the 602 has about twice as much memory, a maximum of 512 program steps, plus 22 data registers. There is also one extra L register which allows 11 rather than ten levels of parenthesis, and the subroutine stack is nine rather than four deep, allowing nesting to nine levels. The program memory is user partitionable, allowing from 22 to 88 data registers (in steps of one) with from 512 to 32 program steps (eight steps per register). The partition is set by a MODE · n instruction which gives memories MO-M (n-1) plus an F register for every ten M registers. The display shows the partition as, for example, M00-74, F-6F⁰⁷², meaning 72 program steps are available. MODE · · displays the partition (which is retained on power off) without changing it. Memory management is automatic in that, if the memory contains programs and the partition is set below the occupied number of steps, the calculator automatically assigns sufficient steps, rather than crashing with an error message. Memory addresses now require two digits, ie, 01, 09, 23, and the display prompts for them thus, M— —. One small drawback is that memory addresses above 22 are no longer fully merged in program memory; Min 25 occupies two steps, whereas Min 09 only occupies one.

The Alphanumerics

The 602p has a full upper and lower case alphabet, plus symbols Σ, (), μ, <, >, ■, ?, !, *, /, →, ←, :, ;, π and space. These can only be written in ALPHA mode, selected by INV MODE. The lower case are the shifted upper case and the symbols shifted numbers. The alpha characters are designed strictly for prompts and result labelling as they cannot be stored in data registers, and no string functions are provided. In other words, alphas may only be entered into the display in manual mode or written into programs; in program memory they are displayed as quoted strings which enter the display only if execution is halted. When more than ten characters are entered, the display scrolls left automatically; this scrolling may be stopped with HLT and single stepped with FST. No cursor is provided, so alpha strings cannot be edited a character at a time, only deleted *in toto* and re-entered. To enable the labelling of results, a function AR n is included in a programmed alpha string. This displays the contents of data register n at that point in the displayed string; # does the same for the X-register contents. The alphanumerics are not as sophisticated as those on the HP-41C and far less so than the BASIC string manipulations of the Sharp PC1211. However, they are very easy to use and provide the vital prompting facility which enables complex programs to be

made intelligible in use. They are not at all suitable for text storage or processing of any sort.

One great boon is that the alpha facility has been used in 'write' mode to display the program steps. This means keycodes are no longer necessary; what it says on the key is what you see in the display, making program documentation and editing much easier. Editing facilities are exactly as on the 502p.

Another use the designers have made of the alpha, is in providing a 'password' facility. Any program can be given a password, without the entry of which it cannot be listed or debugged, though it can be run. Don't forget the password, though, or your program is lost; there's no way around it.

Error messages are more informative, eg, 'M-Error', 'Op-Error', '() Error' indicate the source of the error. However, the improved error trapping creates one disappointment. The famous quirk is gone! Calling an illegal indirect address produces a terse 'M-Error' instead of any unorthodox display; given time, though, I'm sure we'll find another chink in the armour.

Conclusions

Casio has taken a sensibly conservative line in the design of the fx-602p and has retained everything that was good about the 502p while offering more of the same. As a result, the degree of compatibility with the older machine is very gratifying. The 602p will not only run any program written for the 502p but will even load from tape programs and data saved on a 502! (The reverse is not possible.) At £74.95 typical selling price (£84.95 rrp) the 602 is obviously intended to replace the 502 rather than be an upmarket relation, which makes it excellent value for money; I expect a flood of secondhand 502s on the market this winter.

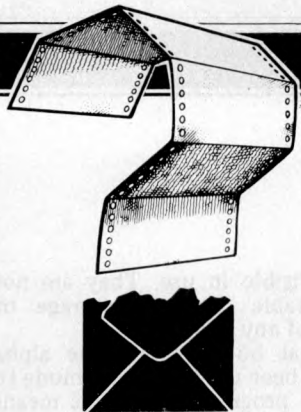
How does the 602p compare with the TI-59, HP41C and Sharp PC1211? I can answer this fairly objectively thanks to a new benchmarking procedure which I owe to the US magazine *Microcomputing*. It consists of writing a program to calculate bond yields from a standard formula:

$$P = I \sum_{j=1}^N (1+Y)^{-j} + M(1+Y)^{-N}$$

with M=20,000, I=1400, N=50 and Y=0.08.

This is a good test of a calculator's abilities using a broad selection of functions, and more revealing than the single function, computer-style benchmarks I have used hitherto. A further nice touch is to count the steps in this program and compute the percentage of total available memory, which makes direct comparison of different machines viable. The only subjective factor left is the quality of the program you write; it must be fully optimised for true

GOTO page 168



COMPUTER ANSWERS

Send your queries to: Sheridan Williams at 35 St Julian's Road, St. Albans, Herts.

Which EPROM?

I wish to purchase several 2716 (5V) EPROMs for my computer. I can find many suppliers for this device in PCW but don't understand the wide variation in price. Are all 2716 (5V) EPROMs the same? I don't wish to make a mistake when purchasing them for my Microtan. *R Moffatt, Belfast*

Price could be a function of access time although most 2716 devices available are 450 ns, which should be adequate for your computer. There are now many manufacturers of 2716 EPROMs and prices, particularly of Japanese versions, have fallen dramatically in recent months. There are also large differences between large (eg 10,000-off) and small (25-off) quantities. The price quoted by a distributor is therefore dependent on the number he can afford to stock.

Your best plan would be to purchase from a reputable distributor, perhaps checking the access time and manufacturer by phoning up first. *Harpenden Micro Group*

TV mod

I get a poor display on my aged television from my TRS 80 although a friend's portable set gives a satisfactory picture. I understand that it is possible to modify a television to give the quality of a monitor, yet retain its ability to receive television pictures. Could you advise me how I would undertake such a conversion or where I could get such a modification done by experts? *K Miles, Ely, Cambs.*

Unless you know someone (eg from a computer club) who is prepared to do the conversion without charging for labour, the cost is likely to be as much as the price of either a portable television, or a monitor. We would advise against attempting such a job yourself, since a mistake might damage you or your computer. If you are not prepared to buy either a TV or a monitor, the cheapest course might be to have your present set re-aligned by your local TV serviceman,

since your computer gives a satisfactory display with your friend's set. *Harpenden Micro Group*

Fans wanted

I can find no-one who can supply me with a small 5 volt fan. I wish to use it in the case of my UK101. Please can you help? *J Johnston, Edinburgh.*

Five volt fans, as you have discovered, are not easily come by. If you really want one, it might be best to buy a 6 V DC motor and attach some kind of fan blade; or alternatively to use a more readily available 12 V fan and connect this to the UK101's DC supply just before the regulator circuit. I am not sure that a DC fan is the best solution to your problem. The difficulty with normal DC fans is that they produce a great deal of electrical interference, which must be screened and suppressed in order to avoid memory corruption and other bugs and glitches. The way round this would be to use an AC fan which usually runs at 240 or 110 V — there is no lack of suppliers for these, as you are probably aware. An alternative solution would be simply to use a more effective heat sink and to mount this where it has a good flow of air — say at the back of the case. One that has a thermal efficiency of about 3 degrees C per watt should work satisfactorily up to about 3 amps, allowing 2 amps for the 101 and a further amp for add-ons. *David Harper*

PET upgrade

In *The PET Revealed* it says that 4116 dynamic RAMs can be inserted 'into the sockets provided' and one can exchange the '4108 chips for 5116'. I'd like to clarify a few points:

Where are these sockets, where is the 4108 chip and how much would an upgrade to 32k cost and would I need professional assistance in installation? Would the above method of upgrading be fully compatible with other peripherals or ROMs? Why do companies advertise memory expansion boards as costing £240+? Can the MTU Hi-Res graphics board address every point (64000=320x200 on the screen? How can the above give an extra 8K of

memory when not in use? Which in your opinion is the best value-for-money editor assembler?

Paul Slade, Petts Wood, Kent.

From your question I deduce that you need the assistance of someone competent in electronics. The memory chips are at the front right of the main circuit board and are not necessarily in sockets. Without the necessary expertise, you are taking a great risk in attempting to remove the chips that are soldered in place. Usually, but not always, an 8k PET has eight 4108s and eight vacant locations. The latter may be mutilated to prevent upgrading with memory of doubtful origin. Even if you do succeed in replacing 8 x 4108 with 16 x 4116, some address linking on the circuit board has to be changed accordingly. I suggest you consider the memory expansion units on Commodore's list of 'Approved Products'.

Extra memory added as above simply expands the space available to Basic. It can only affect other peripherals that use the expansion bus at the RH side (such as the KC Netkit).

Paying an expert to do the job complete costs more than tinkering about with the parts (at first).

Every point (or pixel, to use the video term) corresponds to a single bit in the extra 8k (ie, 8x8k pixels). When not in use for graphics, it is available for storage but not as contiguous memory for Basic.

I have no opinion as to which is best. The CBM assembler package has comprehensive features, but requires a 16/32k PET with disks. For the novice the Mikro assembler chip from Supersoft in conjunction with the 'Toolkit' is a useful combination.

Ron Geere, Editor, IPUG Newsletter.

Atom RUN

I have an Acorn Atom and I believe that there is a way of running programs directly off cassette. Can you please tell me how to do it?

R Jones, Wigan, Lancs.

The command which allows you to run programs directly off cassette is the *RUN command. This is really

intended for running machine code programs but can, with care, be used to run Basic programs as well.

Programs are recorded on the Atom with an entry point which is used by *RUN. Using the SAVE command, Basic records an entry point of C2B2, which is effectively a NEW command if you try to *RUN the program — hence it appears never to have loaded your program! If however you save your Basic program with an entry point of CE86, you will find that *RUN works as you would expect.

You will find however that if your program dimensions arrays it is likely to lurch into incomprehensible behaviour. This is because the normal RUN command, unlike *RUN, does a certain amount of 'setting up' which obviously you haven't done. To overcome this you must set the 'free space pointer', which is described in *Atomic Theory and Practice*, page 145; see also pages 45 and 53. The free space pointer is stored in locations 35 and 36, decimal. TOP is not set either — if you use TOP you must also preset this; it is held in locations 12 and 14, decimal.

These must both be done before you dimension any arrays. They should both be set to any suitable area of free memory — you can find where is free with P & TOP.

Thus, to save a Basic program for auto running: P & TOP

2AF4>*SAVE"PROG"

2900 2AF4 CE86

NEW

*RUN "PROG"

Richard Meredith, Atom User Group

Atom book

Is there a book similar to Tim Hartnell's *Making the most of your ZX80* for the Acorn Atom?

Mrs D Hand, Bury, Lancs

Currently the only book that I know of is *The Atom Magic Book*, available by post from Timedata Ltd, 57 Swallowdale, Basildon, Essex, price £5.50.

The book offers a selection of programs, almost entirely games, novelties and demonstrations, and finishes with a reference section. They have resisted the temptation to re-hash the information in the handbook as some authors do and have succeeded in

producing a booklet that starts where the handbook leaves off, taking you on to a number of programs demonstrating a variety of programming techniques. Because of this, the booklet is of interest at a number of levels: the newcomer will be able to show off his Atom and put it to use, the novice programmer can see how programs work and can adopt some of the techniques used for his own programs, while the expert will find the reference section useful to extend his knowledge of the Atom.

I would add that the book is by no means the last word on the subject and there is scope for a more detailed book to be written. Other books may appear very soon and they may be of interest too, keep an eye on the adverts! (*One just did appear* — Getting Acquainted With Your Acorn Atom by Trevor Sharples and Tim Hartnell. It costs £7.95 and is available from Database Consultancy, 105 Fairholme Avenue, Gidea Park, Romford — Ed)

Alan Taylor

ZX80 v M65

Could you please comment on advantages and disadvantages of Sinclair ZX80 against Microtan 65. I have a 24in b&w TV and access to several cassette recorders.

Riley Williams, Boston

The most serious disadvantage of the ZX80 is that whenever the computer does anything useful the display blanks out making moving graphics almost impossible. Many people have found that after using their ZX80 for a long period the computer goes 'funny' because the regulator overheats. The solution is a carton of cold milk (or something else cold) on the top of the micro or a larger heatsink on the regulator. The ZX80's keyboard is small and rather fiddly, making typing slow and cumbersome.

ZX80 Basic is integer and lacks many functions but another ROM for £20 gives it full floating point arithmetic and other useful functions. ZX80 RAM can be expanded from the 1k provided to 16k for £50 by a plug-in package. Sinclair claims 1k provided to 16k for £50 by a plug-in package. Sinclair claims 1k of RAM in the ZX80 to be approximately equal to 4k RAM in a 'conventional' computer. The main advantage of the ZX80 is, of course, price. It costs only £100 ready built.

The main disadvantage of the Microtan 65 over the ZX80 is price. A Basic system would cost upward of £350, a machine code system £145. Its only other

disadvantage that I can see is that when using the cassette interface without Basic or XBUG it is necessary to have the cassette handling program in RAM. This problem only occurs when using TANEX-Microtan 65 has no cassette interface. The cassette interface is, however, much faster than that of the ZX80.

The Microtan 65 comes with exceptionally good documentation. It is easily expanded by TANEX and a motherboard. The Basic is excellent, it seems to offer the ultimate refinement of the language. The Machine code monitor 'TANBUG' is also excellent, providing all you need besides cassette handling.

The display is flicker-free but only gives 16 lines of 32 characters (ZX80 has 24 lines of 32 characters). No graphic symbols are provided (ZX80 has 22) but it does have pixel graphics and lower case options.

Both computers should work with your TV and cassette recorder but with Microtan you must supply connecting leads.

Alun G Jones

Store query

How are line numbers stored in the Video Genie & TRS80?

M Sondergaard, Huddersfield.

The Video Genie and the TRS-80 (Model 1) are software compatible and use almost identical Basic interpreters. Thus any manual written for one can be used for the other.

PEEKing through the memory locations (PEEK(I)) will give the decimal values of the bytes in these locations. The ASCII values are obtained with (CHR\$(PEEK(I))) and enable one to see the text as one sees it in a Basic line.

Consider this mini-program:
10 PRINT "THIS IS A BASIC LINE":GOTO 20

If you now PEEK through memory from location 17129 onwards, you will find the Basic text. Each line is stored as follows:

Bytes 1,2 — pointer to next program line (line 20)
Bytes 3,4 — line number (line 10) (stored in least significant byte format).

Basic key words (eg PRINT) are stored as one byte codes to save memory. These codes are detailed on page E/1 of the TRS80 manual. Text is stored as ASCII characters and line numbers, referred to by GOTO, GOSUB etc., are also in ASCII format.

The end of the line is represented by 00.

You can now PEEK around in memory and see how Basic programs are stored. The task would be made easier by using a commercial monitor (a program which enables one

to look at any area of memory, and move or alter it), such as MON3, DEBUG, or RSM2. A more detailed explanation can be found in W Barden's book, *Programming Techniques in Level 2 Basic* £2.50 from Tandy.

N Robinson

ITT trio

I would like to ask three questions: I want to use an ALF Music Synthesiser card with an ITT 2020, will I have trouble because the ITT graphics are different from the Apple graphics? Are there any other synthesisers available? I wish to learn programming in machine code. Is there a book on the subject written especially for the ITT 2020?

Jean-Jacques Borremans, Leuven, Belgium

There are two ALF music synthesiser cards which give either three channels and a greater range of notes (the MC16 unit) or nine channels (including stereo) but with less versatility (the MC1). You can use up to three MC16 boards and obtain stereo and nine channels, but that really puts the cost up somewhat. You really must decide whether you want a serious 'instrument'. They both cost about £100. You will want to have at least 4 channels with most music to play chords so you will need at least two MC16s if you are to be at all serious. If you are that serious then the Mountain Hardware Synthesiser is a better buy, you will have the nine voices that you would get for £350 for three ALF Cards plus much more for a similar price with the Mountain Hardware System. The main difference is that the ALF cards only 'play' square waves and you can only get variations on synthesiser music with them, whereas the Mountain Hardware System allows you to manipulate sine waves and so synthesise real instruments. The use of either system is an end in itself apart from the other uses of the Apple or ITT 2020 and the full use of the Mountain Hardware System (or the ALF Cards) is not something you will

pick up overnight, although you can be playing and writing music virtually straightaway.

A third synthesiser which does not appear to have crossed the Atlantic yet is the VISTA Music Machine, which has nine voices. It is claimed to simulate three ALF Cards and will play ALF-generated music. It sells for \$130 in the States. As to the versatility and comparison of the ALF cards, you should read *Personal Computer World* May 1981 p116.

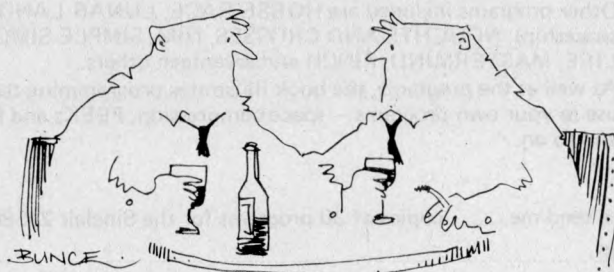
You will have no trouble with an ALF Card on an ITT 2020. The Entry program, in Hi-Res graphics is not quite as clear but I have used the card on an ITT 2020 with no problems. Just clear the graphics page by typing HGR and HGR2 before you run the Entry program.

There is no book specially written for machine-code programming on the ITT 2020, but there is one for the Apple. It covers all but Hi-Res graphics, which is difficult enough on the Apple, and even experienced machine-code programmers have been known to tear their hair out with the ITT 2020 graphics. The book is called 'Apple Machine Language', and the authors are Don and Kurt Inman; the publishers are Prentice-Hall and the price £6.95 (paperback). It is an excellent book for the beginner since it takes you into machine code through Basic, at an easy pace. It is easily the best book on machine-code programming I have seen for a beginner, for any microprocessor.

John Sharp, Secretary, The British Apple Systems User Group.

In P L McIlmoyle's reply to M Crofts of Leeds in June 1981, he mentions that an answer to the high resolution graphics on the UK101 is the new programmable character generator at £81. I have been informed that Magnum Electronics, 3 New Inns Lane, Rubery, Birmingham B45 9TS (021-453 4004) retail the same board direct at only £45 all inclusive except for the 2 x 2114s, or a bare board at £19.50.

SW



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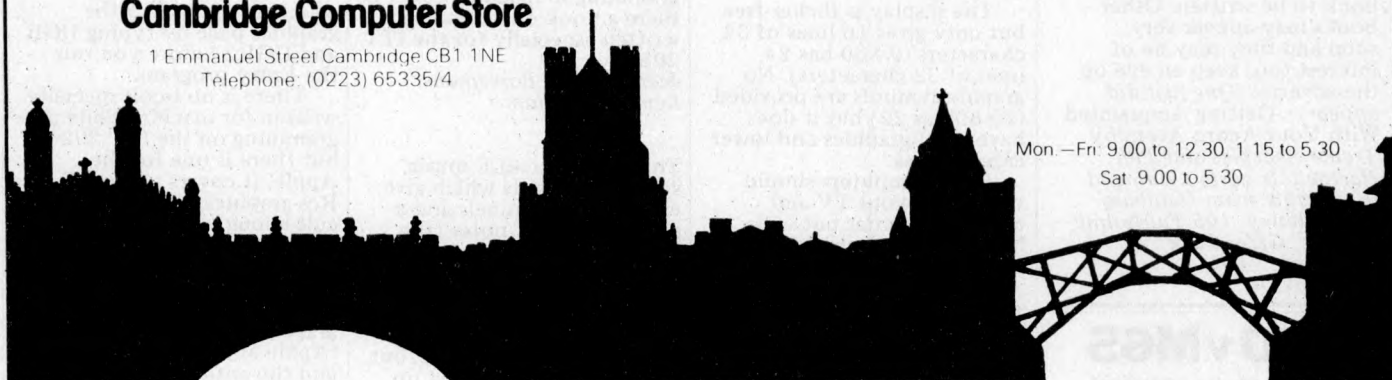
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NEWCOMERS-START HERE

This is our unique quick-reference guide, reprinted every month to help our readers pick their way through the most important pieces of (necessary) jargon found in PCW. While it's in no way totally comprehensive, we trust you'll find it a useful introduction. Happy microcomputing!

Welcome to the confusing world of the microcomputer. First of all, don't be fooled; there's nothing complicated about this business, it's just that we're surrounded by an immense amount of necessary jargon. Imagine if we had to continually say 'numbering system with a radix of 16 in which the letters A to F represent the values ten to 15' when instead we can simply say 'hex'. No doubt soon many of the words and phrases we are about to explain will eventually fall into common English usage. Until that time, *PCW* will be publishing this guide — every month.

We'll start by considering a microcomputer's functions and then examine the physical components necessary to implement these functions.

The microcomputer is capable of receiving information, *processing* it, storing the results or sending them somewhere else. All this information is called *data* and it comprises numbers, letters and special symbols which can be read by humans. Although the data are (yes, it's plural) accepted and output by the computer in 'human' form, inside it's a different story — they must be held in the form of an electronic code. This code is called *binary* — a system of numbering which uses only 0s and 1s. Thus in most micros each character, number or symbol is represented by eight binary digits or *bits* as they are called, ranging from 00000000 to 11111111.

To simplify communication between computers, several standard coding systems exist, the most common being *ASCII* (American Standard Code for Information Interchange). As an example of this standard, the number five is represented as 00110101 — complicated for humans, but easy for the computer! This collection of eight bits is called a *byte* and computer freaks who spend a lot of time messing around with bits and bytes use a half-way human representation called *hex*. The hex equivalent of a byte is obtained by giving each half a single character code (0–9, A–F): 0=0000, 1=0001, 2=0010, 3=0011, 4=0100, 5=0101, ... E=1110 and F=1111. Our example of 5 is therefore 35 in hex. This makes it easier for humans to handle complicated collections of 0s and 1s. The machine detects these 0s and 1s by recognising different voltage levels.

The computer processes data by reshuffling, performing arithmetic on, or by

comparing them with other data. It's the latter function that gives a computer its apparent 'intelligence' — the ability to make decisions and to act upon them. It has to be given a set of rules in order to do this and, once again, these rules are stored in *memory* as bytes. The rules are called *programs* and while they can be input in binary or hex (*machine code* programming), the usual method is to have a special program which translates English or near-English into machine code. This speeds programming considerably; the nearer the *programming language* is to English, the faster the programming time. On the other hand, program execution speed tends to be slower.

The most common microcomputer language is *Basic*. Program instructions are typed in at the keyboard, to be coded and stored in the computer's memory. To run such a program the computer uses an *interpreter* which picks up each English-type instruction, translates it into machine code and then feeds it into the *processor* for execution. It has to do this each time the same instruction has to be executed.

Two strange words you will hear in connection with *Basic* are *PEEK* and *POKE*. They give the programmer access to the memory of the machine. It's possible to read (*PEEK*) the contents of a byte in the computer and to modify a byte (*POKE*).

Moving on to *hardware*, this means the physical components of a computer system as opposed to *software* — the programs needed to make the system work.

At the heart of a microcomputer system is the central processing unit (*CPU*), a single microprocessor chip with supporting devices such as *buffers*, which 'amplify' the CPU's signals for use by other components in the system. The packaged chips are either soldered directly to a printed circuit board (*PCB*) or are mounted in sockets.

In some microcomputers, the entire system is mounted on a single, large, PCB; in others a *bus system* is used, comprising a long PCB holding a number of interconnected sockets. Plugged into these are several smaller PCBs, each with a specific function — for instance, one card would hold the CPU and its support chips. The most widely-used bus system is called the *S100*.

The CPU needs memory in which to keep programs and data. Microcomputers generally have two types of

memory, *RAM* (Random Access Memory) and *ROM* (Read Only Memory). The CPU can read information stored in RAM — and also put information into RAM. Two types of RAM exist — *static* and *dynamic*; all you really need know is that dynamic RAM uses less power and is less expensive than static, but it requires additional, complex, circuitry to make it work. Both types of RAM lose their contents when power is switched off, whereas ROM retains its contents permanently. Not surprisingly, manufacturers often store interpreters and the like in ROM. The CPU can only read the ROM's contents and cannot alter them in any way. You can buy special ROMs called *PROMs* (Programmable ROMs) and *EPROMs* (Erasable PROMs) which can be programmed using a special device; EPROMs can be erased using ultra-violet light.

Because RAM loses its contents when power is switched off, *cassettes* and *floppy disks* are used to save programs and data for later use. Audio-type tape recorders are often used by converting data to a series of audio tones and recording them; later the computer can listen to these same tones and re-convert them into data. Various methods are used for this, so a cassette recorded by one make of computer won't necessarily work on another make. It takes a long time to record and play back information and it's difficult to locate one specific item among a whole mass of information on a cassette; therefore, to overcome these problems, floppy disks are used on more sophisticated systems.

A floppy disk is made of thin plastic, coated with a magnetic recording surface rather like that used on tape. The disk, in its protective envelope, is placed in a disk drive which rotates it and moves a *read/write head* across the disk's surface. The disk is divided into concentric rings called *tracks*, each of which is in turn subdivided into *sectors*. Using a program called a *disk operating system*, the computer keeps track of exactly where information is on the disk and it can get to any item of data by moving the head to the appropriate track and then waiting for the right sector to come round. Two methods are used to tell the computer where on a track each sector starts: *soft sectoring* where special signals are recorded on the surface and

hard sectoring where holes are punched through the disk around the central hole, one per sector.

Half-way between cassettes and disks is the *stringy floppy* — a miniature continuous loop tape cartridge, faster than a cassette but cheaper than a disk system. *Hard disk* systems are also available for microcomputers; they store more information than floppy disks, are more reliable and information can be transferred to and from them much more quickly.

You, the user, must be able to communicate with the computer and the generally accepted minimum for this is the visual display unit (*VDU*), which looks like a TV screen with a typewriter-style keyboard; sometimes these are built into the system, sometimes they're separate. If you want a written record (*hard copy*) of the computer's output, you'll need a *printer*.

The computer can send out and receive information in two forms — *parallel* and *serial*. Parallel input/output (*I/O*) requires a series of wires to connect the computer to another device, such as a printer, and it sends out data a byte at a time, with a separate wire carrying each bit. Serial I/O involves sending data one bit at a time along a single piece of wire, with extra bits added to tell the receiving device when a byte is about to start and when it has finished. The speed that data is transmitted is referred to as the *baud rate* and, very roughly, the baud rate divided by ten equals the number of bytes being sent per second.

To ensure that both receiver and transmitter link up without any electrical horrors, standards exist for serial interfaces; the most common is *RS232* (or *V24*) while, for parallel interfaces to printers, the *Centronics* standard is popular.

Finally, a *modem* connects a computer, via a serial interface, to the telephone system allowing two computers with modems to exchange information. A modem must be wired into the telephone system and you need British Telecom's permission; instead you could use an *acoustic coupler*, which has two obscene-looking rubber cups into which the handset fits, and which has no electrical connection with the phone system — British Telecom isn't so uppity about the use of these.

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and **SHARP MZ-80B**
(see review in this Issue)

at

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COMPUTERS**

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COMPUTERS**

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PACKAGES

**DIRECT
ACCESS**

PCW's 'Packages' section is produced bi-monthly, alternating with our 'In Store' hardware guide. We have confined coverage to business packages which are available and supported at national level and which have been in use for at least six months in a minimum of five sites. Producers of packages which fall within these constraints should send details or updates to: Packages, PCW, 14 Rathbone Place, London W1P 1DE.

The layout has been designed to allow you to discover which packages are available for the application you have in mind and to show you which packages are available for your computer if you already have a machine. In either case the code enables you to look up the supplier's name and telephone number in the table below.

All details published are the latest made available — some may have changed since this issue went to press.

Code	Company	Telephone
A1	ACT/Petsoft	021-454 5348
A2	Arden Data Processing	0533 22255
B1	B + B Computer Ltd.	0204 26644
B2	Beam Business Centre	01-636 1392
B3	Benchmark Computer Systems	0726 61000
B4	Bristol Software Factory	0272 23430
B5	Byte Soft Systems Ltd	0533 531441
C1	CAP-CPP Products Ltd.	01-404 0911
C2	Commodore	01-388 5702
C3	Compsoft	0483 39665
C4	Comput-a-crop	01-499 6987
C5	Computastore Ltd.	01-499 6987
C6	Computech	01-794 0202
C7	Compass	Standish 426252
D1	Data Bank	0509 217671
G1	Graffcom Systems Ltd.	01-734 8862
G2	Grama (Winter) Ltd.	01-636 8210
G3	Great Northern	0532 589980
H1	A. J. Harding	0424 220391
H2	Hartford Software	0606 76265
H3	H. B. Computers	0536 83922
H4	Hipposoft	0332 23127
I1	Intereurope Software Design	0734 786644

I2	Intex Datalog Ltd	0642 781193
J1	T. V. Johnson	0276 62506
K1	Katanna Management Services	0245 76127
K2	Keen Computers	0602 583254
L1	Lifeboat Associates	01-836 4663
L2	Lifeboat (Exidy Sorcerer Firmware)	0736 798157
L3	Livport (Exidy Sorcerer Firmware)	01-679 4321
M1	Ludhouse (Computing) Ltd.	0734 470425
M2	Micro Computer Applications Ltd.	26803
M3	Microtek.	051 426 7271
P1	Microsys Ltd	025671 2434
P2	Padmede Computer Services	01-626 8121
R1	Personal Computers Ltd.	051-521 5830
S1	Rockliff	0474 55813
S2	SMG Micro Computers	01-637 2108
S3	The Softwarehouse	0202 23570
S4	Stage One Software	0268 284601
S5	Systematics International	01-250 0505
S6	Sumlock Bondain	01 602 6242
S7	Stemmos	0279 415260
T1	Software Aids Int	021 622 1754
V1	Tridata Micros Ltd.	062-84 74789
X1	Vlasak Electronics Ltd.	061 682 7555
X1	Xetal	

Applications

Machine	Application	Price	Code
Appointments planner	Commodore/Computhink Challenger	£100 £25	S3 C7
Assembler dev	PET/CBM	£50	L2
Bank accounts	Apple II Commodore/Computhink ITT 2020 PET	£10 £100 £10 £10	D1 S3 D1 D1
Bill of materials	CP/M	£500	B5
Bonds/pension quotations	Commodore/Computhink	£100	S3
Budgeting package	MCZ Zilog Apple/Apple II	£500 + £125	I1 P2
Bureau de change	CBM	£8	H3
Cash flow	Apple II Apple II CP/M CP/M PET	£125 £80 £250 £95 £8	P2 V1 L3 B5 A1
Cash register	Apple II ITT 2020 PET	£10 £10 £10	D1 D1 D1
CBasic	Tandy Model II	£70	M1
Company secretary	CP/M	£450	C4
Conference organiser	MCZ Zilog	£500 +	I1
Contract costing	CP/M	£2000	L3
CP/M & utilities	Tandy Model II	£150	M1
Credit control	Apple II PET	£98 £650	P2 B4
Customer file	Famos	£1000	M2
Database management/Information retrieval	ACT800 Apple Apple Apple Apple Apple II Apple II/ITT 2020 Commodore/Computhink CP/M CP/M Cromemco Famos North Star Horizon PET PET PET PET/CBM PET/CBM PET/CBM PET/CBM Superbrain Tandy Model I TRS-80 TRS-80 TRS-80 8000 Series	£225 £150 £150 £60-140 £150 £75 £100 £45-250 £150-750 £100 £250 £1500 £250 £170 £325 £225 £75 £50/150 £150 £150 £300 £25-80 £60 £150 £32.50 POR	H4 A2 K2 S2 S5 P2 S4 S3 C4 G3 B3 M2 B3 C3 A1 H4 B1 C2 J1 G2 S6 M1 S2 J1 H1 C2
Disk operating system	PET/CBM	£150	B1
Estate agent	Apple Apple Apple	£850 £850 £850	A2 S5 K2

	Apple II	£175	P2
	Apple II/ITT 2020	£750	S4
	CBM	£30	H3
	Commodore/Computhink	£250	S3
	CP/M	£750	C4
	North Star		
	Horizon	£750	B5
	PCC 2000		
	Simplec Triton 3	£350	B3
	PET	£25	A1
	Superbrain	£600	S6
Equipment lease/rent/HP	CP/M	£400	G1
Financial modelling	CP/M	£400	G1
	Apple/ Apple II	£450	P2
	CP/M	£95	B5
Financial planning	Apple II/ITT2020	£250	S4
General ledger/NL	Apple	£300	A2
	Apple	£300	S5
	Apple	£300	K2
	Apple II	£455	P2
	Apple II	£225	V1
	Apple II	£295	C6
	CBM	£200	H3
	Commodore/Computhink		
	CP/M	POR	S3
	CP/M	£500	L3
	CP/M	£500	K1
	CP/M	£375	L1
	CP/M	£500	C4
	CP/M	£400	G1
	CP/M	£400	M3
	CP/M	£200	B5
	CP/M	£275	S6
	CP/M	£275	S7
	Cromemco	£250	B3
	ITT 2020	£295	C6
	ITT 2020/Apple II	£250P	S4
	North Star		
	Horizon	£250	B3
	North Star		
	Horizon	£400	M3
	PCC 2000		
	Simplec Triton 3	£350	B2
	PET/CBM	£200	C2
	Sharp PC3201	£450	P2
	Superbrain	£400	M3
	Superbrain	£400	S6
	Tandy Model I	£90	M1
Tandy Model II	£90	M1	
TRS-80	£225	H1	
TRS-80 I	£225/325	T1	
TRS-80 I	£325	K1	
TRS-80 II	£425	T1	
Vector	£400	C5	
8080/Z80	£357	L1	
8080/Z80	£275	G3	
Hire purchase	Cromemco	£400 +	B3
Incomplete records	Apple	£250	S2
	Apple	POR	K2
	Apple II	£425	P2
	Commodore/Computhink		
	CP/M	£750	S3
	CP/M	£750	M3
	CP/M	£250	B5
	North Star		
Horizon	£750	M3	
Superbrain	£750	M3	
Tandy Model I	£40	M1	
TRS-80	£40	H1	
Individual designed programs	TRS-80 I	£100 +	K1

Industry Factory loading	Apple CP/M PET	£360 £360 £300	X1 X1 X1
Industry work study	Apple CP/M PET	£990 £990 £750	X1 X1 X1
Integrated accts	Altos (CP/M, MP/M) Apple II Apple II Apple II Commodore/Computhink CP/M CP/M CP/M CP/M CP/M Cromemco Famos ITT 2020 MZ-80K North Star Horizon PET/CBM North Star Horizon PET/CBM PET/CBM PET/CBM Superbrain Superbrain Tandy Model I Tandy Model II TRS-80 Vector 8000 Series 8080/Z80 8080/Z80	£300 £450 £300 £855 POR £950 £1500 £1100 £990 £690 £850 £950 £2000 £450 £150 £950 £300 £990 £(50) £650 £650 £990 £1200 £350 £350 £75 £1000 POR £950 £995	B1 P1 P2 V1 S3 L1 C4 G1 M3 B5 S7 M2 P1 P2 B3 B1 M3 C2 J1 G2 M3 S6 M1 M1 J1 C5 C2 L1 G3
Investment portfolio	TRS-80	£20	S2
Invoicing	Apple Apple II Apple II Apple II Challenger Commodore/Computhink CP/M CP/M CP/M CP/M CP/M Cromemco North Star Horizon North Star Horizon PET PET/CBM PET/CBM PET/CBM Superbrain Superbrain Tandy Model I Tandy Model II TRS-80 TRS-80 TRS-80 TRS-80 8080/Z80 ITT 2020	£295 £300 £300 £140 £25 POR £500 £325 £150-350 £250 £150 £100 £100 £250 £350 £25-50 POR £250 £150 £90 £90 £90 £25 £75 £75 £75 £125 £325 £300	S2 P1 P2 V1 C7 S3 K1 L1 C4 M3 S7 B3 B3 M3 A1 B1 J1 M3 S6 M1 M1 M1 H1 T1 K1 T1 L1 P1
Job costing	Apple II Apple CP/M CP/M CP/M CP/M ITT 2020 North Star Horizon PET Superbrain Tandy Model I Tandy Model II	£300 £990 £700 £350 £990 £300 £350 £750 £350 POR £350 POR POR	P1 X1 C4 M3 X1 P1 M3 X1 M3 M1 M1
Job order control	8080/Z80	£275	G3
Leasing	Cromemco	£400 +	B3
Legal precedents	CP/M	£1100	C4
Letter writer	Apple II CP/M North Star Horizon Superbrain	£80 £150 £150 £150 £150	V1 M3 M3 M3 M3
Lisp	PET/CBM	£75	C2
Lotteries	PET	£45	H2
Mailing list	Altos (CP/M, MP/M) Apple Apple Apple Apple Apple II Apple II Apple II/ITT 2020 CBM Commodore/Computhink CP/M CP/M ITT 2020 PET PET PET PET/CBM PET/8032 Tandy Model I	£75 £300 £50-150 £300 £300 £40 £50 £100 £35 £100 £50-150 £250 £50 £45 £50 £15 £75 £75/150 £40	B1 A2 S2 S5 K2 P2 D1 S4 H3 S3 C4 G1 D1 H2 D1 A1 B1 S1 M1

PACKAGES

Application	Machine	Price	Code
	Tandy Model II	£75	M1
	TRS-80	£50-150	S2
	TRS-80	£25/38/55	H1
Mail shot	Apple	£14	S2
	Apple II	£40	P2
	Challenger	£25	C7
	Commodore/Computhink	£125	S3
	CP/M	£200-360	C4
	CP/M	£90	M3
	CP/M	£75	S7
	MCZ Zilog	£250	I1
	North Star		
	Horizon	£90	M3
	PCC 2000		
	Simpelec Triton 3	£450	B2
	Superbrain	£90	M3
	Tandy Model II	£75	M1
Membership accting	Apple/Apple II	£75	P2
	PET	£85	H2
Motor Dealer	Famos	£5000	M2
Order entry/invoicing	CP/M	£350	G1
Order processing	CP/M	£550	L1
	8080/Z80	£550	L1
Office admin	Apple II/ITT 2020	£100	S4
Pad to plotter systems	Apple II	£250	P2
Pascal	Apple/Apple II	£299	P2
	PET/CBM	£120	C2
Payroll	Apple	POR	A2
	Apple	£200	S2
	Apple	POR	S5
	Apple	POR	K2
	Apple II	£200	P2
	Apple II	£375	V1
	Apple II	£375	C6
	Apple II	£10	D1
	Apple II/ITT 2022	£250P	S4
	Challenger	£25	C7
	CBM	£10	H3
	CP/M	£450	L3
	CP/M	£500	K1
	CP/M	£475	L1
	CP/M	£495	C4
	CP/M	£500	G1
	CP/M	£390	M3
	CP/M	£500	B5
	Cromemco	£350	B3
	Famos	£1500	M2
	ITT 2020	£375	C6
	ITT 2020	£10	D1
	North Star		
	Horizon	£350	B3
	North Star		
	Horizon	£390	M3
	PET	£200/350	C5
	PET	£50/25/195	A1
	PET	£50/195	I2
	PET	£10	D1
	PET/CBM	£150	G2
	PET/CBM	£150	J1
	PET/CBM	£150	C2
	Sorcerer	£250	L2
	Superbrain	£390	M3
	Superbrain	£400	S6
	Tandy Model I	£249	M1
	TRS-80	£200	H1
	TRS-80I	£218	K1
	TRS-80I	£218	T1
	TRS-80II	£375	T1
	8000 Series	£250	C2
	8080/Z80	£475	L1
	8080/Z80	£275	G3
	PET/CBM	£150	G2
	PET/CBM	£150	J1
	PET/CBM	£150	C2
	Sorcerer	£250	L2
	Tandy Model I	£249	M1
	TRS-80	£200	H1
	TRS-80I	£218	K1
	TRS-80I	£218	T1
	TRS-80II	£375	T1
	8000 Series	£250	C2
	8080/Z80	£475	L1
	8080/Z80	£275	G3
Personnel records	Apple II	£98	P2
	CP/M	£450	C4
	MCZ Zilog	£500+	I1
	PET	£85	H2
Petaid report generator	Commodore/Computhink	£125	S3
Petsoft programs	PET/CBM	£160	J1
Planning/Maintenance	PET/8032	£595	S1
Postal advertising response package	Apple	£350	S2
PR/advertising package	Commodore/Computhink	£1000	S3
Price lister	CBM	£12	H3
Printers job control	Commodore/Computhink	£250	S3
Production analysis	Apple II	£75	P2
	CP/M	£700	C4
	PET/CBM	£300	B1
Prof appts groups	8080/Z80	£275	G3
Prof appts individ	8080/Z80	£220	G3
Prof client billing	8080/Z80	£330	G3

Application	Machine	Price	Code
Programming aids	Apple II	£40	P2
Property management	CP/M	£450-1000	C4
	CP/M	£400	M3
	North Star		
	Horizon	£400	M3
	Superbrain	£400	M3
Purchase ledger	Apple	£300	A2
	Apple	£300	S5
	Apple	£300	K2
	Apple II	£295	C6
	Apple II	£300	P1
	Apple II	£300	P2
	Apple II	£315	V1
	Apple II/ITT 2020	£250P	S4
	CBM	£350	H3
	Challenger	£25	C7
	Commodore/Computhink	POR	S3
	CP/M	£500	C4
	CP/M	£450	G1
	CP/M	£500	L3
	CP/M	£500	K1
	CP/M	£425	L1
	CP/M	£400	M3
	CP/M	£200	B5
	CP/M	£275	S7
	Cromemco	£250	B3
	ITT 2020	£295	C6
	ITT 2020	£300	P1
	North Star		
	Horizon	£250	B3
	North Star		
	Horizon	£400	M3
	Superbrain	£400	M3
	Superbrain	£300	S6
	PCC 2000		
	Simpelec Triton 3	£350	B2
	PET	£300	B4
	PET	£95/120/350	A1
	PET/CBM	£200	C2
	PET/CBM	POR	J1
	PET/8032	£395	S1
	Sharp PC3201	£300	P2
	Tandy Model I	£90	M1
	Tandy Model II	£90	M1
	TRS-80	£225	H1
	TRS-80I	£225	T1
	TRS-80I	£225	K1
	TRS-80II	£375	T1
	Vector	£400	C5
	8000 Series	£250	C2
	8080/Z80	£275	G3
	8080/Z80	£425	L1
Revolving credit	Cromemco	£400+	B3
Sales ledger	Apple	£300	A2
	Apple	£300	S5
	Apple	£300	K2
	Apple II	£295	C6
	Apple II	£300	P1
	Apple II	£300	P2
	Apple II	£315	V1
	Apple II/ITT 2020	£250P	S4
	CBM	£350	H3
	Challenger	£25	C7
	Commodore/Computhink	POR	S3
	CP/M	£500	C4
	CP/M	£450	G1
	CP/M	£500	L3
	CP/M	£500	K1
	CP/M	£425	L1
	CP/M	£400	M3
	CP/M	£200	B5
	CP/M	£275	S7
	Cromemco	£250	B3
	ITT 2020	£295	C6
	ITT 2020	£300	P1
	North Star		
	Horizon	£250	B3
	North Star		
	Horizon	£400	M3
	PCC 2000		
	Simpelec Triton 3	£350	B2
	PET	£300	B4
	PET	£800	C1
	PET	£95/350	A1
	PET/CBM	POR	J1
	PET/CBM	£200	C2
	PET/8032	£395	S1
	Sharp PC 3201	£300	P2
	Superbrain	£400	M3
	Superbrain	£300	S6
	Tandy Model I	£90	M1
	Tandy Model II	£90	M1
	TRS-80	£225	H1
	TRS-80I	£225	T1
	TRS-80I	£225	K1
	TRS-80II	£375	T1
	Vector	£400	C5
	8000 Series	£250	C2
	8080/Z80	£275	G3
	8080/Z80	£425	L1
Salesman	Apple II	£10	D1
	ITT 2020	£10	D1
	PET	£10	D1
Screen generator	MCZ Zilog	£75 +	I1
S/L, P/L & stock control	Apple/Apple II	£900	P2
	CP/M	£1000	L3
Solicitor's complete record accounting	Apple	£3000	S2
Solicitor's package	PET/8032	£750	S1
Statistics	Apple	£150	G3
	Apple II	£100-195	P2

Application	Machine	Price	Code
	TRS-80	£45	S2
Stock control/recording	Altos (CP/M, MP/M)	£300	B1
	Apple	POR	A2
	Apple	POR	K2
	Apple	POR	S5
	Apple	£150	G3
	Apple	£80	S2
	Apple II	£75/300	P2
	Apple II	£10	D1
	Apple II	£285	V1
	Apple II	£300	P1
	Apple II/ITT 2020	£500	S4
	CBM	£35/25	H3
	Challenger	£25	C7
	Commodore/Computhink	£100/250	S3
	CP/M	£500	K1
	CP/M	£325	L1
	CP/M	£500-1500	C4
	CP/M	£350	G1
	CP/M	£900	M3
	CP/M	£500	B5
	Cromemco	£450	B3
	Famos	£1500	M2
	ITT 2020	£10	D1
	ITT 2020	£300	P1
	MZ-80K	£150	P2
	North Star		
	Horizon	£450	B3
	North Star		
	Horizon	£900	M3
	PCC 2000		
	Simpelec Triton 3	£350	B2
	PET	£12/25/350	A1
	PET	£10	D1
	PET	£195	I2
	PET	£300	B4
	PET	£15	A2
	PET/CBM	£300	B1
	PET/CBM	£150	C2
	PET/CBM	£150	J1
	PET/CBM	£150	G2
	PET/Computhink	£250	R1
	PET/8032	£395	S1
	Sharp PC3201	£300	P2
	Superbrain	£900	M3
	Superbrain	£300	S6
	Tandy Model I	£30-50	M1
	Tandy Model II	£300	M1
	TRS-80	£48	S2
	TRS-80	£200	H1
	TRS-80	£115	J1
	TRS-80I	£200	K1
	TRS-80I	£200	T1
	TRS-80II	£375	T1
	8080/Z80	£275	G3
	8080/Z80	£325	L1
TAP business system	PET	£125	H2
Text file librarian	Apple II/ITT 2020	£125	S4
Time/cost recording	Apple	£450	S2
	Apple II	£300	P1
	Commodore/Computhink	POR	S3
	CP/M	£400	G1
	CP/M	£200	M3
	Cromemco	£250	B3
	ITT 2020	£300	P1
	North Star		
	Horizon	£250	B3
	North Star		
	Horizon	£200	M3
	PCC 2000		
	Simpelec Triton 3	£350	B2
	PET/CBM	£300	B1
	Superbrain	£200	M3
	Tandy Model I	POR	M1
	Tandy Model II	POR	M1
Travel agency accts	Superbrain	£800	S6
Utilities	Apple/Apple II	£40	P2
	Apple II	£20	C6
	ITT 2020	£20	C6
Utility set	CBM	£78	H3
VAT	PET	£17.50	A1
VAT master	CBM	£25	H3
VAT register	TRS-80	£15	H1
Vet package	PET/8032	POR	S1
Video message	Apple	£200	G3
Warehousing	PET/8032	POR	S1
Word processing	ACT 800	£375	H4
	Apple	£60	S2
	Apple	£75	K2
	Apple	£75	S5
	Apple	£75	A2
	Apple II	£150-300	P2
	Apple II	£75	J1
	Apple II	£120	V1
	Apple II	£40	D1
	Apple II/ITT 2020	£180/95	S4
	CBM	£35	H3
	Commodore/Computhink	£120	S3
	CP/M	£500	K1
	CP/M	£150-260	C4
	CP/M	£400	G1
	CP/M	£250	M3
	Famos	£500	M2
	ITT 2020	£40	D1
	MCZ Zilog	£500+	I1
	North Star		
	Horizon	£250	M3

DIRECT ACCESS

Machine	Application	Price	Code
	PET	£85/65/ 40/20	H2
	PET	£40	D1
	PET	£375	H4
	PET	£25/325	A1
	PET	£325	C5
	PET/CBM	£75/150	C2
	PET/CBM	£75/150	J1
	PET/CBM	£75/150	G2
	Superbrain	£250	M3
	Tandy Model I	£50/75	M1
	Tandy Model II	£175-240	M1
	TRS-80	£30/60/90	S2
	TRS-80	£45/95	J1
	TRS-80	£15	H1
	TRS-80I	£70	K1
	Vector	£400	C5
	8000 Series	£250	C2

Machines

ACT 800	Database management/	£225	H4	
	Word processing	£375	H4	
Altos (CP/M, MP/M)	Integrated accts	£300	B1	
	Mailing list	£75	B1	
	Stock control/recording	£300	B1	
Apple	Database management/ information retrieval	£150	K2	
	Database management/ information retrieval	£150	A2	
	Database management/ information retrieval	£60-140	S2	
	Database management/ information retrieval	£150	S5	
	Database management	£75	P2	
	Estate agent	£850	S5	
	Estate agent	£850	A2	
	Estate agent	£850	K2	
	General ledger/NL	£300	K2	
	General ledger/NL	£300	A2	
	General ledger/N/L	£450	P2	
	General ledger/NL	£300	S5	
	Incomplete records	POR	K2	
	Incomplete records	£250	S2	
	Incomplete records	£450	P2	
	Industry factory loading		£360	X1
	Industry work study		£990	X1
	Invoicing		£295	S2
	Invoicing		£300	P2
	Job costing		£450	S2
	Job costing		£990	X1
	Mailing list		£300	K2
	Mailing list		£300	A2
	Mailing list		£40	P2
	Mailing list		£50-150	S2
	Mailing list		£300	S5
	Mail shot		£14	S2
	Payroll		POR	S5
	Payroll		POR	K2
	Payroll		POR	A2
	Payroll		£200	S2
	Postal advertising response package		£350	S2
	Purchase ledger		£300	K2
	Purchase ledger		£300	P2
	Purchase ledger		£300	A2
	Purchase ledger		£300	S5
	Sales ledger		£300	A2
	Sales ledger		£300	K2
	Sales ledger		£300	S5
	Sales ledger		£300	P2
	Solicitor's complete record accounting		£3000	S2
	Statistics		£150	G3
	Statistics		£100/195	P2
	Stock control/recording		£150	G3
	Stock control/recording		POR	K2
	Stock control/recording		£300	P2
	Stock control/recording		POR	A2
	Stock control/recording		£80	S2
	Stock control/recording		POR	S5
	Time/cost recording		£450	S2
Video message		£200	G3	
Word processing		£75	K2	
Word processing		£75	A2	
Word processing		£60	S2	
Word processing		£300	P2	
Word processing		£75	S5	
Apple II	Bank account	£10	D1	
	Cash flow	£80	V1	
	Cash flow	£75	P2	
	Cash register	£10	D1	
	Database management/ information retrieval	£98	P2	
	General ledger/NL	£225	V1	
	General ledger/NL	£450	P2	
	General ledger/NL	£295	C6	
	Incomplete records	£300	P2	
	Integrated accts	£855	V1	
	Integrated accts	£450	P1	
	Integrated accts	£300	P2	
	Invoicing	£140	V1	
	Invoicing	£300	P1	
	Invoicing	£300	P2	
	Job costing	£300	P1	
	Letter writer	£80	V1	
	Mailing list	£50	D1	
	Mailing list	£40	P2	
	Mail shot	£225	P2	
	Pad to plotter system	£250	P2	
	Payroll	£375	V1	
	Payroll	£200	P2	
Payroll	£375	C6		
Payroll	£10	D1		
Personnel records	£75	P2		
Production analysis	£75	P2		
Programming aids	£40	P2		

Application	Machine	Price	Code
	Purchase ledger	£315	V1
	Purchase ledger	£300	P1
	Purchase ledger	£300	P2
	Purchase ledger	£295	C6
	Sales ledger	£315	V1
	Sales ledger	£300	P1
	Sales ledger	£300	P2
	Sales ledger	£295	C6
	Salesman	£10	D1
	Statistics	£100-195	P2
	Stock control/recording	£285	V1
	Stock control/recording	£300	P1
	Stock control/recording	£300	P2
	Stock control/recording	£10	D1
	Time/cost recording	£300	P1
	Utilities	£20	C6
	Word processing	£120	V1
	Word processing	£150-300	P2
	Word processing	£40	D1
	Word processing	£75	J1

Apple II/ ITT 2020	Database management/ information retrieval	£100	S4
	Estate agent	£750	S4
	Financial planning	£250	S4
	General ledger/NL	£250P	S4
	Mailing list	£100	S4
	Office admin	£100	S4
	Payroll	£250P	S4
	Purchase ledger	£250P	S4
	Sales ledger	£250P	S4
	Stock control/recording	£500	S4
	Text file librarian	£125	S4
	Word processing	£180/95	S4

CBM	Bureau de change	£8	H3
	Estate agent	£30	H3
	General ledger/NL	£200	H3
	Mailing list	£35	H3
	Payroll	£10	H3
	Price lister	£12	H3
	Purchase ledger	£350	H3
	Sales ledger	£350	H3
	Stock control/recording	£35/25	H3
	Utility set	£78	H3
	VAT master	£25	H3
	Word processing	£35	H3

Challenger	Appointment Planner	£25	✓
	Invoicing	£25	✓
	Mail Shot	£25	✓
	Payroll	£25	✓
	Purchase Ledger	£25	✓
	Sales Ledger	£25	✓
	Stock Control	£25	✓

Commodore/ Computhink	Appointments planner	£100	S3
	Bank accounts	£100	S3
	Bonds/pension quotations	£100	S3
	Database management/ information retrieval	£45-250	S3
	Estate agent	£250	S3
	General ledger/NL	POR	S3
	Incomplete records	£750	S3
	Integrated accts	POR	S3
	Invoicing	POR	S3
	Mailing list	£100	S3
	Mail shot	£125	S3
	Petail report generator	£125	S3
	PR/advertising package	£1000	S3
	Printers job control	£250	S3
	Purchase ledger	POR	S3
	Sales ledger	POR	S3
Stock control/recording	£100/250	S3	
Time/cost recording	POR	S3	
Word processing	£120	S3	

CP/M	Bill of materials	£500	B5
	Cash flow	£250	L3
	Cash flow	£95	B5
	Company secretary	£450	C4
	Contract costing	£2000	L3
	Database management/ information retrieval	£150-750	C4
	Database management/ information retrieval	£100	G3
	Equipment lease/rent/ HP	£400	G1
	Estate agents	£750	C4
	Financial modelling	£400	G1
	Financial modelling	£95	B5
	General ledger/NL	£500	L3
	General ledger/NL	£500	C4
	General ledger/NL	£400	G1
	General ledger/NL	£500	K1
	General ledger/NL	£375	L1
	General ledger/NL	£200	B5
	General ledger/NL	£275	S7
	General ledger/NL	£400	M3
	Incomplete Records	£250	B5
	Incomplete Records	£750	M3
	Industry factory loading	£360	X1
	Industry work study	£990	X1
	Integrated accts	£1500	C4
	Integrated accts	£1100	G1
	Integrated accts	£950	L1
	Integrated accts	£690	B5
	Integrated accts	£850	S7
	Integrated accts	£990	M3
	Invoicing	£325	L1
	Invoicing	£150-350	C4
	Invoicing	£500	K1
	Invoicing	£150	S7
	Invoicing	£250	M3
	Job costing	£700	C4
	Job costing	£990	X1
	Job costing	£350	M3
	Legal precedents	£1100	C4
	Letter Writer	£150	M3
	Mailing list	£50-150	C4
	Mailing list	£250	G1

	Mailing list	£75	S7
	Mail shot	£200-360	G4
	Mail shot	£90	M3
	Order entry/invoicing	£350	G1
	Order processing	£550	L1
	Payroll	£450	L3
	Payroll	£495	C4
	Payroll	£500	G1
	Payroll	£500	K1
	Payroll	£475	L1
	Payroll	£500	B5
	Payroll	£390	M3
	Personnel records	£450	C4
	Production analysis	£700	C4
	Property management	£450-1000	C4
	Property management	£400	M3
	Purchase ledger	£500	L3
	Purchase ledger	£450	G1
	Purchase ledger	£500	K1
	Purchase ledger	£425	L1
	Purchase ledger	£500	C4
	Purchase ledger	£200	B5
	Purchase ledger	£275	S7
	Purchase ledger	£400	M3
	Sales ledger	£500	L3
	Sales ledger	£500	C4
	Sales ledger	£450	G1
	Sales ledger	£500	K1
	Sales ledger	£425	L1
	Sales ledger	£200	B5
	Sales ledger	£275	S7
	Sales ledger	£400	M3
	S/L, P/L + stock control	£1000	L3
	Stock control/recording	£325	L1
	Stock control/recording	£500-1500	C4
	Stock control/recording	£350	G1
	Stock control/recording	£500	K1
	Stock control/recording	£500	B5
	Stock control/recording	£900	M3
	Time/cost recording	£400	G1
	Time/cost recording	£200	M3
	Word processing	£500	K1
	Word processing	£400	G1
	Word processing	£150-260	C4
	Word processing	£250	M3
Cromemco	Database management/information retrieval	£250	B3
	General ledger/NL	£250	B3
	Hire purchase	£400 +	B3
	Integrated accts	£950	B3
	Invoicing	£100	B3
	Leasing	£400 +	B3
	Purchase ledger	£250	B3
	Revolving credit	£400 +	B3
	Sales ledger	£250	B3
	Stock control/recording	£450	B3
	Time/cost recording	£250	B3
Famos	Customer file	£1000	M2
	Data base	£1500	M2
	Integrated accts	£2000	M2
	Motor dealer	£5000	M2
	Payroll	£1500	M2
	Stock control	£1500	M2
	Word processing	£500	M2
ITT 2020	Bank account	£10	D1
	Cash register	£10	D1
	General ledger/NL	£295	C6
	Integrated accts	£450	P1
	Invoicing	£300	P1
	Job costing	£300	P1
	Mailing list	£50	D1
	Payroll	£10	D1
	Payroll	£375	C6
	Purchase ledger	£300	P1
	Purchase ledger	£295	C6
	Sales ledger	£300	P1
	Sales ledger	£295	C6
	Salesman	£10	D1
	Stock control/recording	£10	D1
	Stock control/recording	£300	P1
	Time/cost recording	£300	P1
	Utilities	£20	C6
	Word processing	£40	D1
MCZ Zilog	Budgeting package	£500 +	I1
	Conference organiser	£500 +	I1
	Mail shot	£200	I1
	Personnel records	£500 +	I1
	Screen generator	£75 +	I1
	Word processing	£500 +	I1
MZ-80K	Integrated accounts	£150	P2
	Stock control/recording	£150	P2
North Star Horizon	Database management/information retrieval	£250	B3
	Estate agent	£750	B5
	General ledger/NL	£250	B3
	General ledger/NL	£400	M3
	Incomplete records	£750	M3
	Integrated accts	£950	B3
	Integrated accts	£990	M3
	Invoicing	£100	B3
	Invoicing	£250	M3
	Job costing	£350	M3
	Letter writer	£150	M3
	Mail shot	£90	M3
	Payroll	£350	B3
	Payroll	£390	M3
	Property Management	£400	M3
	Purchase ledger	£250	B3
	Purchase ledger	£400	M3
	Sales ledger	£250	B3
	Sales ledger	£400	M3
	Stock control/recording	£450	B3
	Stock control/recording	£900	M3
	Time/cost recording	£250	B3
	Time/cost recording	£200	M3
	Word processing	£250	M3

Machine	Application	Price	Code
PCC 2000 Simpelec Triton 3	Estate Agent	£350	B2
	General ledger/NL	£350	B2
	Mail Shot	£450	B2
	Purchase ledger	£350	B2
	Sales ledger	£350	B2
	Stock control/recording	£350	B2
	Time/cost recording	£350	B2
PET	Bank account	£10	D1
	Cash flow	£8	A1
	Cash register	£10	D1
	Credit control	£650	B4
	Database management/ information retrieval	POR	C1
	Database management/ information retrieval	£325	A1
	Database management/ information retrieval	£225	H4
	Database management/ information retrieval	£170	C3
	Estate agent	£25	A1
	General ledger/NL	£1000	C1
	Industry factory loading	£300	X1
	Industry work study	£750	X1
	Invoicing	£350	A1
	Invoicing	£400	C1
	Job costing	£750	X1
	Lotteries	£45	H2
	Mailing list	£15	A1
	Mailing list	£50	D1
	Mailing list	£45	H2
	Membership actting	£85	H2
	Payroll	£50/195	I2
	Payroll	£10	D1
	Payroll	£50/25/	
	Payroll	195	A1
	Payroll	POR	C1
	Payroll	£200/350	C5
	Personnel records	£85	H2
	Purchase ledger	£95/120/	
	Purchase ledger	350	A1
	Purchase ledger	£1000	C1
	Purchase ledger	£300	B4
	Sales ledger	£300	B4
	Sales ledger	£800	C1
	Sales ledger	£95/350	
	Salesman	£10	D1
	Stock control/recording	£195	I2
	Stock control/recording	£10	D1
	Stock control/recording	£12/25/	
	Stock control/recording	350	A1
	Stock control/recording	£15	A2
	Stock control/recording	£300	B4
	TAP business system	£125	H2
	VAT	£17.50	A1
	Word processing	£40	D1
	Word processing	£85/65/	
	Word processing	40/20	H2
	Word processing	£375	H4
	Word processing	£25/325	A1
	Word processing	325	C5
PET/CBM	Assembler dev	£50	C2
	Database management/ information retrieval	£75	B1
	Database management/ information retrieval	£50/150	C2
	Database management/ information retrieval	£150	G2
	Database management/ information retrieval	£150	J1
	Disk operating system	£150	B1
	General ledger/NL	£200	C2
	Integrated accts	£300	B1
	Integrated accts	£(50)	C2
	Integrated accts	£650	G2
	Integrated accts	£650	J1
	Invoicing	POR	J1
	Invoicing	£25-50	B1
	Lisp	£75	C2
	Mailing list	£75	B1
	Pascal	£120	C2
	Payroll	£150	G2
	Payroll	£150	J1
	Payroll	£150	C2
	Petsoft programs	£160	J1
	Production analysis	£300	B1
	Purchase ledger	£200	C2
	Purchase ledger	POR	J1
	Sales ledger	POR	J1
	Sales ledger	£200	J1
	Stock control/recording	£150	C2
	Stock control/recording	£300	B1
	Stock control/recording	£150	G2
	Stock control/recording	£150	J1
	Time/cost recording	£300	B1

Machine	Application	Price	Code
	Word processing	£75/150	J1
	Word processing	£75/150	G2
	Word processing	£75/150	C2
PET/CBM	Assembler dev	£50	C2
	Database management/ information retrieval	£75	B1
	Database management/ information retrieval	£50/150	C2
	Database management/ information retrieval	£150	G2
	Database management/ information retrieval	£150	J1
	Disk operating system	£150	B1
	General ledger/NL	£200	C2
	Integrated accts	£300	B1
	Integrated accts	£(50)	C2
	Integrated accts	£650	G2
	Integrated accts	£650	J1
	Invoicing	POR	J1
	Invoicing	£25-50	B1
	Lisp	£75	C2
	Mailing list	£75	B1
	Pascal	£120	C2
	Payroll	£150	G2
	Payroll	£150	J1
	Payroll	£150	C2
	Petsoft programs	£160	J1
	Production analysis	£300	B1
	Purchase ledger	£200	C2
	Purchase ledger	POR	J1
	Sales ledger	POR	J1
	Sales ledger	£200	J1
Sharp PC-3201	General ledger	£450	P2
	Sales ledger	£300	P2
	Purchase ledger	£300	P2
	Stock control	£300	P2
Sorcerer	Payroll	£250	L2
	Payroll	£250	L2
Superbrain	Database	£300	S6
	Estate agent	£800	S6
	General ledger	£400	M3
	General ledger	£400	S6
	Incomplete Records	£750	M3
	Integrated Accts	£1200	S6
	Integrated Accts	£990	M3
	Invoicing	£250	M3
	Invoicing	£150	S6
	Job costing	£350	M3
	Letter writer	£150	M3
	Mail shot	£90	M3
	Payroll	£400	S6
	Payroll	£390	M3
	Property management	£400	M3
Tandy Model I	Purchase ledger	£300	S6
	Purchase ledger	£400	M3
	Sales ledger	£300	S6
	Sales ledger	£400	M3
	Stock control	£300	S6
	Stock control	£900	M3
	Time recording	£200	M3
	Word processing	£250	M3
	Travel agency accts	£800	S6
	Travel agency accts	£800	S6

Application	Machine	Price	Code
Tandy Model II	Word processing	£50/75	M1
	CBasic	£70	M1
	CP/M + utilities	£150	M1
	General ledger/NL	£90	M1
	Integrated accts	£350	M1
	Invoicing	£90	M1
	Job costing	POR	M1
	Mailing list	£75	M1
	Mail shot	£75	M1
	Purchase ledger	£90	M1
	Sales ledger	£90	M1
	Stock control/recording	£300	M1
	Time/cost recording	POR	M1
	Word processing	£175-240	M1
TRS-80	Database management/ information retrieval	£60	S2
	Database management/ information retrieval	£32.50	H1
	Database management/ information retrieval	£150	J1
	General ledger/NL	£225	H1
	Incomplete records	£40	H1
	Integrated accts	£75	J1
	Investment portfolio	£20	S2
	Invoicing	£25	H1
	Mailing list	£25/38/	
	Mailing list	55	H1
	Mailing list	£50-150	S2
	Payroll	£200	H1
	Purchase ledger	£225	H1
	Sales ledger	£225	H1
	Statistics	£45	S2
	Stock control/recording	£200	H1
	Stock control/recording	£48	S2
	Stock control/recording	£115	J1
	VAT register	£15	H1
	Word processing	£45/95	J1
TRS-80I	Word processing	£15	H1
	Word processing	£30/60/	
	Word processing	90	S2
	General ledger/NL	£225/325	T1
	General ledger/NL	£325	K1
	Individual designed programs	£100 up	K1
	Invoicing	£75	K1
	Invoicing	£75	T1
	Payroll	£218	T1
	Payroll	£218	K1
TRS-80II	Purchase ledger	£225	K1
	Purchase ledger	£225	T1
	Sales ledger	£225	T1
	Sales ledger	£225	K1
	Stock control/recording	£200	K1
	Stock control/recording	£200	T1
	Word processing	£70	K1
	General ledger/NL	£425	T1
	Invoicing	£125	T1
	Payroll	£375	T1
Vector	Purchase ledger	£375	T1
	Sales ledger	£375	T1
	Stock control/recording	£375	T1
	General ledger/NL	£400	C5
	Integrated accts	£1000	C5
8000 Series	Purchase ledger	£400	C5
	Sales ledger	£400	C5
	Word processing	£40	C5
	Database management/ information retrieval	POR	C2
	Integrated accts	POR	C2
8080/Z80	Payroll	£250	C2
	Purchase ledger	£250	C2
	Sales ledger	£250	C2
	Word processing	£250	C2
	General ledger/NL	£275	G3

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PET 32k. . . cassette, soundbox, toolkit, printer, dust cover, manuals, PET Revealed, CPUCNs, approx 60 tapes inc arcade games, £775 ono. Tel 01-226 8624 after 5.

Sharp PC-1211. . . and cass int, little used hence as new cond, offers around £90. Tel Seaford (0323) 891755.

ITT 2020 48k. . . colour, 6 months old, disk drive 3 months old, paddles, software, manuals, £1000. Tel: Beaconsfield (049-46) 77162.

Used. . . Computer Automation minicomputer inc card cage, PSU, processor card, 16k core, front panel console, offers. Tel 08926 64307 eves.

Cheap printer. . . Creed teleprinter (new) with int to any computer parallel output port, drive s/ware available for a Sorcerer, easily adapted to any Z80 computer, £50 ono. Ring Watford 41405.

Nascom 2. . . 16k RAM B board, Veroframe, Easicom stereo sound generator (AY-3-8910), graphics ROM, PSU, Microsoft Basic, £420. Tel 0493 76329 after 6.

Atari. . . games console plus 8 games, value £250, accept £220 ono. 7 months old. Also Elf II 4k, giant board, PSU, light pen, manuals, £200 ono. Tel Leicester 552575.

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Sharp MZ-80 P3. . . printer & I/O unit, brand new & unused, offers please. Tel Stevenage (0438) 59677.

Sharp MZ-80K. . . 48k, with Sharp printer, int unit, etc. All equipment in immac cond & under guarantee, also £100+ s/ware, £950 the lot or will split. Tel Seaford (0323) 891755.

Latest CBM 8032. . . and 1 Meg 8050 drive and Ricoh RP1600 daisywheel (with four type faces) and Wordcraft 80 and 10 disks, hardly used. Cost £3600, only £2790. Tel: 01-940 0838.

TRS-80 16k L2. . . with lower case mod, green screen monitor, cass recorder, manual, 10 months old, very little used, £370. Tel 01-778 8835.

Centronics. . . microprinter P1, brand new, inc 3 spare paper rolls, offers? Also TRS-80 printer interface for above, £30. Tel Seaford (0323) 891755.

ZX81. . . Sinc built, perfect working order, inc leads, manual, adaptor, £65 only. Still under guarantee. Compatible tape recorder, £20. Tel Guildford 64137, ask for A J Shah, Room 5.

16k RAM, 8k ROM. . . ZX80 (with '81 keyboard overlay), 3 cassettes, 8k & 4k manuals, PSU, tape & TV leads, Sinc built, Tel 061-766 8364 after 5 except w/ends.

PET 2001 32k. . . new ROM, small keyboard, 5 months old, dust cover, Basic toolkit, Microchess, Invaders, Startrek & others, sound lead, manuals, £500. Tel 0252 48154.

PET 16k. . . new ROM, large keyboard, 6 months old, toolkit, built-in sound & reset, PET Revealed, manuals, about 100 progs, £600. Tel South Benfleet 52147.

TRS-80 L2 32k. . . with exp int, VDU, cass rec, manuals, new style keyboard, numerical key pad, over £500 of s/ware (games & utilities), only £550. Tel 01-540 0474 after 5.

Sharp PC-1211. . . brand new, offers please, Tel Stevenage (0438) 59677.

TRS80 4k L1. . . inc CPU 12" VDU and manuals, software and machine language manual, 6 months old as new in original casing, £299. Phone Sheffield 654327 after 6.

Sinclair ZX81. . . & PSU, brand new & unused, unwanted gift, £60. Tel Seaford (0323) 891755.

OSI-160. . . extra memory boards, fits UK101 or Superboard, 16k RAM exp up to 24k, disk int, req 5V PSU, full doc, £200. Tel Rugeley (08894) 77245 eves, ask for Chris.

ZX81. . . factory built, with manual, PSU, Sinclair games tape, all boxed, £60. Tel Dick, 01-771 0090.

TRS-80 L2. . . progs, approx £50 on tape, £25 ono, inc Space Invaders, some space games, 2 books of Basic games (approx 200), £7 ono; TRS-80 graphics, £1 ono. Buyer collects. Tel Adam, Northwood 27733.

TRS-80 L1 4k. . . keyboard with modulator, PSU, games cassette, boxed, as new, £250. Tel 01-724 2318 between 12.00 & 2.00 (Miss Baudhuin) or 01-229 6098 after 6.30.

Teletype. . . Data Dynamics ASR390 with paper tape reader/punch, stationery, ribbons, manuals, diagrams, vgc, £150. Tel answering machine with mic, cassette, diagrams, £15. Tel Eastbourne 642559.

ZX81. . . 8k Basic + 4A PSU (fitted with 1A reg), excellent cond, £68. 4800BPS cass int, board with data £12. Tel Lei (0533) 730653 after 5.

UK101. . . 8k, uncased, in good working order, some program, full documentation, £200 open to offers. Tel: Hornchurch 72472.

TRS-80 16k L2. . . with CTR81 cassette recorder, £340 ono. 3 months old. Tel: Merthyr Tydfil (0685) 71111 ext. 340 before 5pm, ask for Eric.

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USER GROUPS INDEX

*These are updates/new entries received since our last full listing.
The next complete list will be printed in our November issue.*

INTERNATIONAL

CP/M, IRL, Irish CP/M Users' Group. Meets monthly in Dublin area, membership IR £5 pa. Newsletter: CP/M.MAG. Contact: Doug Notley, Gardner House, Ballsbridge, Dublin 4, tel: 01-686411.

Ithaca Intersystems and S100 Bus Users' Club. Formed to 'organise the construction and design of software and hardware based on Ithaca or other S100 systems.' Contact: George Brooke, Sebastian Baverstrasse 20c, 8000 Munich 83, W Germany.

NATIONAL

CP/M Users' Group (UK). Annual sub £6. S/ware library, newsletters, meetings, 'help' service. Contact: 11 Sun Street, Finsbury Square, London EC2M 2PS, tel: 01-247 0691.

EZUG: Educational ZX80/1 Users' Group. Annual sub £2.50 (UK), £3 (rest of Europe), £6/\$12 elsewhere. Bimonthly newsletter. Large SAE for sample newsletter (UK & Eire only). Contact: Eric Deeson, Highgate School, Balsall Heath Rd, Highgate, Birmingham B12 9DS

ZX80/81 National Software Association. Annual sub £6, incs cassette of software. Bimonthly newsletter, software available on cassette. Send SAE for details. Contact: 15 Woodlands Rd, Wombourne, Staffs WV5 0JZ.

BASUG — British Apple Systems User Group. Now incorporates the UK Apple User Group. Caters for all current and prospective Apple/ITT 2020 users. Publishes magazine called Hard Core, meets fortnightly at Park Street, just south of St Albans. Contact: Martin Perry, BASUG, PO Box 174, Watford WD2 6NF.

Educational Users' Group for TRS-80 & Video Genie. Offshoot of Nat TRS-80 UG, other TRS-80/Video Genie users welcome. Contact: D J Fatcher, Head Teacher Beaconsfield First & Middle School, Beaconsfield Rd, Southall, Middx.

COUNTY

N Herts area CBM/PET/VIC users' group. Regular meetings, talks, affiliated to IPUG. Contact: P Mortiboy 2 Spurr's Close, Hitchin, Herts SG4 9OE, tel: Hitchin (0462) 54435.

Manchester area TRS-80 Users' Group. Contact: Francis Glenister, 13 Pridmouth Road, Withington, Manchester M20 9GN, tel: 061-445 7191.

Merseyside Microcomputer Group. Special interest groups: PET, Apple, 380Z, SC/MP. Education (Mr M Trotter, 051-652 1596). Contact: Fred Shaw 14 Albany Avenue, Eccleson Park, Prescott, Merseyside L34 2QW tel: 051-426 5436.

Suffolk Microcomputer Club. Meets monthly, produces newsletter, sub £5 pa. Contact: Mr S Pratt, c/o Microtek, 15 Lower Brook St, Ipswich, Suffolk IP4 1AQ tel: 0473 50152.

NE RML 380Z Users' Group. Meets monthly at MEC, Newcastle-upon-Tyne Polytechnic, Coach Lane Campus. Contact: M Hatfield or R Reed, tel: 26002 ext 268 (office hours)

South Shropshire: Ludlow & Dist Microcomputer Club. Meets 7.30 2nd Monday monthly at Diocesan Education Centre, Lower Galdeford, Ludlow. Contact: David Pauli, 32 High

St, Leintwardine, Craven Arms, Shropshire, tel: 05473 287.

TOWN

Cambridge Microcomputer Club. Meets 3rd Wednesday monthly at Portland Arms, Cambridge. Contact: Duncan Mackay, 4 High Street, Waterbeach, tel: 63137 (day).

Oxford University Microcomputer Society. Meets weekly in Clarendon laboratory, Oxford, visiting speakers, micros available for programming. Contact: Richard Ash, Christchurch, Oxford.

South Oxford Computer Club. Covers Wantage, Abingdon, Didcot, Wallingford and Newbury. Meets 1st Tues monthly at The Star, East Ilsley. Contacts: Mike 0235 834402; Malcolm, 0235 816949; Paul, 0235 815305; Rocky, 0635 34456.

Richmond Computer Club. Meets 8.00 2nd Monday monthly. Richmond Community Centre. Contact: Bob Forster, 01-892 1873 (eve).

Scunthorpe & Dist Microprocessor Society. Contact: G Hinch, 21 Old Crosby, Scunthorpe, S Humberside DN15 8PU.

NETWORK NEWS

Here is a list of all British (and one Dutch) personal computer networks. As more networks appear — and as more facilities are added to existing ones — we'll report them in this section, which appears monthly.

Forum-80 Hull... Operator: Frederick Brown, tel 0482 856169. Facilities: electronic mail, software up/down loading, Forum-80 Users' Group, PET users' section, shopping list. Hours: 7 days/week, midnight-0800, Tues & Thurs 1900-2200, Sat & Sun 1300-2200.

Forum-80 London... Operator: Leon Jay, tel 01-286 6207. Facilities:

electronic mail, program downloading. Hours: Tues, Fri, Sat & Sun 1900-2300.

80-NET... Operators: Leon Heller & Brian Pain. National TRS-80 Users' Group, tel 0908 566660. Facilities: electronic mail, software for downloading, newsletter, TRS-80 information. Hours: 7 days/week, 1900-2200.

CBBS London... Operator: Peter Goldman, tel 01-399 2136. Facilities: electronic mail, program downloading. Hours: Wed 0700-0930 & 1900-2200, Fri 1900-2200, Sun 1600-2200.

Forum-80 Holland... Operator: Nico Karssemeyer, tel 010 313 512 533. Facilities: electronic mail, program up/downloading, shopping list. Hours: Tues-Sat 1800-0700 nightly, continuous from 1800 Sat — 0700 Tues.

DIARY DATA

Readers are strongly advised to check details with exhibition organisers before making travel arrangements to avoid wasted journeys due to cancellations, printer's errors, etc.

Paris, France	Int Conf & Exbn Microprocessing and Microprogramming — Euromicro. Contact: Euromicro, 18 Rue Planchat, 75020 Paris	8 — 10 Sept
London	(Cunard Int Hotel) Personal Computer World Show. Contact: Montbuild, 01-486 1951	10 — 12 Sept
Anaheim, USA	Electronic Show & Convention — Wescon. Contact Network, 028 02 5226	14 — 16 Sept
Bristol	(Exbn Centre) West of England, Electronics Exbn. Contact: Exbns for Industry, 08833 4371.	15 — 17 Sept
Brighton	(Metropole) Int Semiconductor Exbn & Conf. Contact: Kiver Communications, 01-390 0281	22 — 24 Sept
London	(Wembley Conf Centre) Viewdata '81. Contact: Online, 09274 28211	6 — 8 Oct
Friedrichshafen, W Germany	Euro Congress for Word Proc-Intertext. Contact: Int Bodensee-Messe, Meistershofener Str 25, 7790 Friedrichshafen.	21-25 Oct
Stuttgart, W Germany	Hobby Electronics & Minicomputers Exbn. Contact: CES, 01-236 0911	21-25 Oct
London	(Bloomsbury Centre) Computer Graphics Exbn. Contact: Online, 09274 28211	27-29 Oct
London	(West Centre Hotel) Viewdata Exbn. Contact: IPC Exbns, 01-643 8040	4-6 Nov
Madrid, Spain	Int Office Equip & Computers Exbn. Contact: CITEMA, Plaza de conde de valle Suchil 8, Madrid 15	13-20 Nov

PCW SUBSET

Alan Tootill presents more useful assembler — language subroutines.
If you'd like to contribute your routines (for any of the popular processors), send them to:
Sub Set, PCW, 14 Rathbone Place, London W1P 1DE.

6502 code is now coming in and, with it, observations that documentation standards must provide for the use of zero page for addressing, parameter passing and working space. From suggestions put by both Gavin Every and Dave Barrow, we are reserving a block of 16 locations in page zero for 6502 routines. The operand notation for these will be MO to MF and they will be shown in the machine code as 'ZZ'.

For documentation purposes these zero page memory locations will be

considered as registers and included in the section 'REGs USED'. No routine using MO to MF to pass information to or from a routine, or otherwise corrupting them, can be considered re-entrant and class 1 but that shouldn't stop them being used to take advantage of the brevity and speed they make possible.

Our first Datasheet, DUBDIV, from Tim Groves of Burnham-on-Sea, shows how this 6502 documentation works.

Datasheet

```

;= DUBDIV — 16-bit division
;/ CLASS: 2 — not re-entrant
;/ TIME CRITICAL ? No
;/ DESCRIPTION: Divides one 16-bit unsigned binary
;/                number by another
;/ ACTION: Clears locations for the result.
;/          Treats AY as one 16-bit accumulator.
;/          Shifts dividend bit by bit into working accumulator.
;/          Compares with the divisor and subtracts and sets
;/          bits in the result accordingly.
;/ SUBr DEPENDENCE: None
;/ INTERFACES: None
;/ INPUT: The dividend is loaded into M2 and M3 and the
;/        divisor into M4 and M5.
;/ OUPTUT: MO and M1 contain the quotient; A (hi) and Y (lo)
;/        contain the remainder; M2 and M3 are zero; the
;/        divisor in M4 and M5 is unchanged.
;/        After division by zero; M0 and M1 contain high
;/        values (FFFFH and FFFFH) and AY contain the
;/        input dividend.
;/ REGs USED: A, Y and M0 to M5
;/ STACK USE: 2
;/ LENGTH: 56
;/ PROCESSOR: 6502
DUBDIV: TXA                ; save X register          8A
        PHA                ; on stack.              48
        CLD                ; ready for SBC          D8
        LDA #00            ; clear working          A9 00
    
```

ZX80 - 81 SOFTWARE

- * ZX 80 BASIC Fully disassembled
- * ZX 81 BASIC listings @ £7.00 each
- * ZXBUG: Now available for ZX81, also machine code debugging program @ £7.00
- * ADVENTURE: A real machine code ADVENTURE @ £7.00
- * ZXCHESS: The program everyone's waited for written in machine code. @ £10.00

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- VB-3 VoxBox for 6821-type PIA parallel port £57
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- VB-4 RS-232 VoxBox with serial interface* £83

(* note: CTS signal must be available)

- VB-5 RS-232 VoxBox for Superboard/UK101 ... £83
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- VC-2 Atom demonstration cassette £2.50
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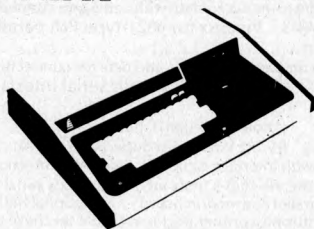
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	TAY	; accumulator	A8
	STA M1	; clear locations	85 ZZ
	STA M0	; for result.	85 ZZ
	LDX #10	; set bit counter	A2 10
LOOP:	ASL M3	; get msb or	06 ZZ
	ROL M2	; dividend into carry.	26 ZZ
	PHA	; put carry	48
	TYA	; into the lsb of	98
	ROL A	; Y register and	2A
	TAY	; ripple the shift	A8
	PLA	; through to	68
	ROL A	; accumulator.	2A
	CMP M4	; wkg acc hi > divisor hi ?	C5 ZZ
	BEQ CHKLO	; hi bytes equal ?	F0 OC
	BCC ROT	; carry = 0 for rotation.	90 OE
SUB:	PHA	; subtract divisor	48
	TYA	; from working accumulator.	98
	SBC M5	;	E5 ZZ
	TAY	;	A8
	PLA	;	68
	SBC M4	;	E5 ZZ
CHKLO:	BCS ROT	; carry = 1 here.	B0 04
	CPY M5	; check lo bytes	C4 ZZ
	BCS SUB	; of divisor & wkg acc.	B0 F2
ROT:	ROL M1	; put in the new	26 ZZ
	ROL M0	; bit of the result.	26 ZZ
	DEX	; decrement bit count.	CA
	BNE LOOP	; all over?	DO DB
	STA M3	; temporary save of acc.	85 ZZ
	PLA	; restore X register	68
	TAX	; from stack.	AA
	LDA M3	; recover accumulator.	A5 ZZ
	RTS	; return.	60

XY=XY/2

6502 coders, it seems, were also frustrated by all that fuss we made of HL=HL/2, since they have no HL. To put things right, Gavin Every of Woking sent

HLFX, our second Datasheet. Remember we want the briefest and also the fastest, if it is not the same, class 1 code to divide four BCD digits in XY by 2, putting any remainder in the carry.

Datasheet

; = HLFXY — BCD digits in XY/2

; CLASS: 1

; TIME CRITICAL ? No

; DESCRIPTION: Divides by 2 four BCD digits in XY (Xhi, Y1o) setting carry if there is a remainder.

; ACTION: A ← X

; A ← A/2

; X ← A

; if half carry then X ← X-3

; A ← Y

; if full carry then Y ← Y + A0

; A ← A/2

; Y ← A

; if half carry then Y ← Y-3

; SUBr DEPENDENCE: None

; INTERFACES: None

; INPUT: XY contains four BCD digits (Xhi, Y1o)

; OUTPUT: XY contains result of division by 2, carry = remainder

; REGs USED: X, Y and P

; STACK USE: None

; LENGTH: 27

; TIME STATES: 38 to 50

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Kent.


```

;/ PROCESSOR: 6502
HLFX: PHA ; save A 48
TXA ; divide first 8A
LSR A ; digit 4A
TAX ; by 2 AA
AND #8 ; check for half carry. 29 08
BEQ HL1 ; if not then jump. F0 03
DEX ; else CA
DEX ; decrement CA
DEX ; three times. CA
HL1: YTA ; other digit pair. 98
BCC HL2 ; check for whole carry out. 90 02
ADC #09F ; if so add 10 to next hi digit 69 9F
HL2: ROR A ; divide by 2. 6A
TAY ; back to Y. A8
AND #8 ; check for half carry. 29 08
BEQ HL3 ; jump if no half carry. F0 03
DEY ; else 88
DEY ; decrement 88
DEY ; three times. 88
HL3: PLA ; restore A. 68
RTS ; return. 60

```

Random numbers

The inelegance in executing HL = HL*257+41mod 2**16 in July's RAND has drawn some heavy fire. Improvements to the 20-byte, 193 t=state routine we printed started at 15 bytes and 116 t-states. But only three, of all your letters gave the optimum code in nine bytes and 74 t-states. This demonstrates the need for the widest possible exposure of code to get at the best. The best came from Gavin Every of Woking and John Phillips of Saltash, new to the series this month and, of course, from Dave Barrow of Hemsworth. Here is the improved code:

```

RAND: PUSH AF F5
      PUSH BC C5
      LD B,L 45
      LD C,+41 OE 29
      ADD HL,BC 09
      POP BC C1
      POP AF F1
      RET C9

```

Don't imagine though that this dis-

poses of the subject. There will be more about random numbers next month.

6809 Arithmetic

Richard Crane of Leeds University sent the next Datasheet, DIVNM, after seeing the four-byte integer divide in the March issue. DIVNM, written for the Motorola M6809 processor, divides two unsigned integer numbers of variable length. Richard points out that, although extensive use is made of instructions unique to M6809, the use of compare significantly improves on the overall speed and is an aspect that can be translated into Z80 code.

I pass on the routine untested, not having an M6809 processor handy just now, because the idea is so good and the routine gives such a good view of the power of the instruction set of this processor, with its two stack pointers. The use of variable length is useful for incorporation in routines of mixed mode arithmetic ie, floating point, double and single byte values.

Datasheet

```

; = DIVNM — Variable length integer divide.
;/ CLASS: 1
;/ DESCRIPTION: Divides one unsigned integer by another.
;/ Dividend may be any length up to N bytes.
;/ Divisor may be any length up to M bytes.
;/ WHERE 31 ≥ N ≥ M ≥ 1
;/ Checks for zero divisor.
;/ ACTION: Long division by shift and subtract.
;/ Use of compare (CMP) and variable length
;/ values optimises for speed.
;/ SUBr DEPENDENCE: None
;/ INTERFACES: None
;/ INPUT: Dividend at U → U + N — 1

```

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```
;/ Divisor at U + N -> U + N + M - 1
;/ M in A
;/ N in B
;/ OUTPUT: Remainder at U -> U + M - 1
;/ Quotient at U + M -> U + M + N - 1
;/ Divisor at U + M + N -> U + 2M + N - 1
;/ M in A
;/ N in B
;/ If divisor = 0 returns as if divisor = 1 and carry set.
;/ REGS USED: None
;/ STACK USE: User stack; 2M + N; System stack: 10
;/ LENGTH: 86
;/ PROCESSOR: M6809
```

```
DIVNM: PSHS A,B,DP,X,Y ; save registers. 34 3E
        LEAX A,U ; set X reg to 30 C6
        LEAX B,X ; point to divisor. 30 85
        CLR B ; clear B, 5F
        TFR B, DP ; and DP. 1F 9B
WORK: PSHU DP ; create M bytes of 36 08
        ORB , -X ; work space and check EA 82
        DEC A ; divisor = 0. 4A
        BNE WORK ; 26 F9
        ORCC #1 ; set carry and 1A 01
        TST B ; branch if divisor 5D
        BEQ RETRN ; is zero. 27 35
        LDB 1,S ; multiply N E6 61
        LSL B ; by 8 for 58
        LSL B ; loop counter and 58
        LSL B ; save on 58
        PSHS B ; stack. 34 04
SHIFT: LDA 2,S ; add size of A6 62
        ADDA 1,S ; dividend to AB 61
        DEC A ; Size of work space. 4A
ROLL: ROL A, U ; rotate 1 bit from 69 C6
        DEC A ; lsb of dividend thru 4A
        BGE ROLL ; to msb work space. 2C FB
        BSR POINT ; set stack pointers. 8D 24
        LEAY ,U ; 31 C4
CMPRR: LDA ,Y+ ; starting at msb worksp A6 AO
        CMPA ,X+ ; compare with divisor. A1 80
        BLO NOGO ; branch if sub not pos. 25 13
        BNE SKIP ; branch if sub is pos. 26 03
        DEC B ; keep comparing bytes. 5A
        BGE CMPRR ; if equal 2C F5
SKIP: BSR POINT ; set stack pointers 8D 15
        CLR A ; clear carry 4F
SUB: LDA B,U ; starting at lsb worksp A6 C5
        SBCA B,X ; subtract divisor A2 85
        STA B,U ; return to workspace A7 C5
        DEC B ; continue to msb 5A
        BGE SUB ; 2C F7
        INC , -X ; increment quotient 6C 82
NOGO: DEC ,S ; decrement loop counter. 6A E4
        BNE SHIFT ; repeat 8 x N times. 26 D5
        PULS A ; discard loop counter. 35 02
        CLR A ; clear carry. 4F
RETRN: PULS A,B,DP,X,Y,PC ; restore registers and 35 BE
        ; return to main program.
POINT: LDB 4,S ; set registers for E6 64
        LEAX B,U ; use as stack pointers 30 C5
        LDB 3,S ; X = U + M + N E6 63
        LEAX B,X ; B = M - 1 30 85
        DEC B ; return to 5A
        RTS ; subroutine. 39
```

Disclaimer

I have nothing to do with the Basic

stuff in the 'programs' section that
often follows Sub Set. Please, no more
rude letters and no more Basic programs!

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LEISURE LINES

by J J Clessa

It seems that the June puzzle was more than usually difficult for you — only 46 replies received of which only 17 obtained the maximum possible score of 97 points. The winning entry, picked at random, came from Mr D L Clay of Coventry. Congratulations — your prize is on its way Mr (Mrs, Miss or Ms) Clay.

The solution (which was one of several possibilities) was: (1+3), (4+5), (2+6+8), (12+13), (16+20), (31+33), (40+41), (9+10+23+26+32), (25+27+34+35), (19+36+37+38+39), (29+30+42+47+48), (11+14+15+17+18+22+24+44+60), (21+28+45+46+52+64), (7+49+51+53+63+66), (50+67+68+69+70), (56+58+59+61+62+65), (54+55+57+77+78+79), (43+71+72+73+74+75+76). This solution uses all the integers and gives the score of 97.

By the way, our prize-distribution system seems to have gone awry again. But please don't panic, we think we've rectified the fault (we've fired the Editor!), and all outstanding commitments will be honoured ASAP.

(In a last-ditch effort to save his job, the editor persuaded the accountant to pay all outstanding prizes. So efficiently was this done that Mr Clay was sent his prize even before this issue was printed! — Ed.)

Quickie

There's a three digit number which: If you add seven to it, it divides exactly by seven

If you add eight to it, it divides exactly by eight

If you add nine to it, it divides exactly by nine

What's the number?

Prize puzzle

Here's a puzzle to test your powers of logic — or even your micro if you've enough imagination to program this problem.

1. In a village near my home there are three pubs only: The White Swan, The Black Bull, The Grey Goose.
2. On Sundays all the pubs are closed.
3. The White Swan opens five days a week, The Black Bull opens four days a week, The Grey Goose opens three days a week.

4. The White Swan is never open four days running, The Black Bull is never open three days running, The Grey Goose is never open two days running.
5. During one three day period: The White Swan was closed on the third day, The Black Bull was closed on the second day, The Grey Goose was closed on the first day.

6. At least one pub is closed on Saturdays and Mondays.

Assuming that days of opening are regular each week, on which day are all the pubs open?

Answers on postcards please to arrive not later than first post September 30th to September Prize Puzzle, PCW, 14 Rathbone Place, London W1P 1DE.

PROGRAMS

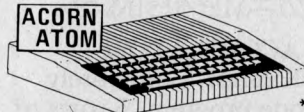
PET Arithmetic Test

by D R Green

```

100 REM BUTTERFLY: ARITHMETIC TESTER
110 REM GAME FOR ONE TO FOUR PLAYERS
120 REM <5 TO 11 YEAR OLD CHILDREN>
130 REM WILL RUN ON OLD OR NEW ROM PET
140 REM DELETE REMS TO KEEP WITHIN 8K
150 REM
160 REM BY D. R. GREEN 1981
170 REM
180 REM TO ALTER DELAYS - CHANGE "DY"
190 REM "T" = 10 OR 12 OR 16 AS YOU
200 REM REQUIRE MAX VALUE OF TABLES
210 REM
220 T=12:DY=500
230 DIMF$(14,4),A$(12),Q$(4),N$(3),H$(3),C$(3),B$(6),L$(4)
240 D$=""
250 L1=158:L2=623:IFPEEK(50003)=0THENL1=525:L2=527
260 PRINT"3":TAB(8):"PRESS 3SPACE BAR TO START
270 GOSUB 1810:GOSUB1670
    
```

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PROGRAMS

```

280 GETA$:IF A$<>" "THEN280
290 PRINT"PLEASE TYPE IN THE CONTESTANTS NAMES
300 PRINT"ENTERING AFTER EACH ONE.
310 PRINT"ENTER AFTER THE LAST PRESS ENTER ON ITS OWN.
320 FORN=0TO3
330 PRINTN+1:"POKEL1,2:POKEL2,45:POKEL2+1,62
340 INPUTB$:IFB$=">"THENPRINT"GO TO360
350 N$(N)=MID$(B$,3,20):PRINT:NEXT
360 IFN=0THEN320
370 IFN=1THENH$(0)=0:GOTO440
380 PRINT"HANDICAPS - 30 IS HARDEST & 20 EASIEST:-"
390 FORI=0TON-1
400 POKEL1,0:PRINT"N$(I):"S HANDICAP IS -> "
410 GETA$:IFA$<"0"ORR$>"9"THEN410
420 H$(I)=2*VAL(A$):PRINTA$:NEXT
430 FORI=1TODY:NEXT
440 PRINT"DO YOU WISH TO TRY ADDITION SUBTRACTION
450 PRINT"MULTIPLICATION OR DIVISION PROBLEMS?
460 PRINT"TYPE THE INITIAL LETTER, OR R FOR A
470 PRINT"RANDOM MIXTURE.
480 POKEL1,0:R=RND(-TI)
490 GETA$
500 IFA$="A"THENP=1:GOTO560
510 IFA$="S"THENP=2:GOTO560
520 IFA$="M"THENP=3:GOTO560
530 IFA$="D"THENP=4:GOTO560
540 IFA$="R"THENP=5:TA=0:GOTO750
550 GOTO490
560 ONPGOSUB1330,1340,1350,1360
570 PRINT"WHICH "S$:"TABLE DO YOU WANT?
580 PRINT"VALUES 1 TO 9."
590 IF T<10THENPRINT
600 IFT>9THENPRINT" & A=10, B=11, C=12,
610 IFT>12THENPRINT"=13, E=14, F=15, G=16,
620 PRINT:PRINT"(R WILL GIVE A RANDOM SELECTION).
630 POKEL1,0
640 GETA$:IFA$=" "THEN640
650 TA=ASC(A$)-48:IFTA<1THEN640
660 IFA$="R"THENTA=0:GOTO750
670 IFTA>9AND(TA<1ORTA>T+7)THEN640
680 IFTA>9THENTA=TA-7
690 PRINT"DO YOU WISH TO SEE THE "S$
700 PRINT"TABLE FOR"TA:"REPEATED ON THE SCREEN?
710 PRINT"ANSWER Y OR N.
720 POKEL1,0
730 GETA$:IFA$<"Y"ANDR$<"N"THEN730
740 IFA$="Y"THENGOSUB1370
750 PRINT"
760 FORI=1TO15:PRINT"
770 PRINT"
780 C$="WOWWOWWOW
790 PRINT"C$
800 FOR I=0TON+1
810 PRINT"N$(I):"S CATERPILLAR
820 C$(I)=H$(I):GOSUB1620:NEXT
830 FORI=0TON-1
840 A2=TA:IFTA=0THENA2=INT(RND(1)*T+1)
850 F=0:R=INT(RND(1)*T+1)
860 FORK=1TO6
870 IFR=B$(K)THENF=1:K=6
880 NEXT:IFF=1THEN850
890 FORK=1TO5:B$(K)=B$(K+1):NEXT
900 B$(6)=R:A1=R
910 ONPGOSUB1480,1510,1540,1570,1600
920 GOSUB1690
930 IFN=1THENPRINT"TRY NOW":D$:GOTO950
940 PRINT"N$(I):"S TURN":D$
950 PRINT"GO":GOSUB2060
960 FORK=0TO4:PRINTLEFT$(G$(K),L$(K)):NEXT
970 G=0:D=1:W=0
980 IFAND9THEND=10:IFAND99THEND=100
990 POKEL1,0
1000 GETA$
1010 W=W+1:IFW>DYTHEN1110
1020 IFA$=" "THEN1000
1030 U=ASC(A$)-48
1040 IFU<0ORU>9THEN1000
1050 G=G+U*W
1060 IFD>1THEND=D*.1:GOTO1000
1070 IFAN=GTHEN1130
1080 PRINT"SORRY, "N$(I):"YOU'RE WRONG":D$
1090 GOSUB1440:NEXT
1100 GOTO830
    
```

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PROGRAMS

```

1110 PRINT"SORRY, "N$(I):" TIME UP";D#
1120 GOTO1090
1130 PRINT"GOOD! "N$(I):" YOU'RE RIGHT";D#
1140 GOSUB1440
1150 FORK=1TO2:C$(I)=C$(I)+1:GOSUB1620:NEXT
1160 IF C$(I)=28THEN1180
1170 NEXT:GOTO830
1180 FORK=1TO4*DY:NEXT
1190 PRINT"WHEN YOU WANT AOTHER GAME
1200 PRINT"PRESS SPACE BAR
1210 FORK=1TO3*DY:NEXT
1220 IF H$(I)<3THEN1290
1230 H$(I)=H$(I)+4
1240 PRINT"SPC(14-LEN(N$(I))*5);N$(I):"S BUTTERFLY
1250 GOSUB1810
1260 POKEL1,0
1270 GETA$:IFA$<>" THEN1270
1280 GOTO440
1290 FORK=0TON-1:IF H$(K)>27THEN1310
1300 H$(K)=H$(K)+2
1310 NEXT
1320 GOTO1220
1330 S$="ADDITION":RETURN
1340 S$="SUBTRACTION":RETURN
1350 S$="MULTIPLICATION":RETURN
1360 S$="DIVISION":RETURN
1370 PRINT"2":A2=TA
1380 FORA1=0TOT
1390 ONPGOSUB1480,1510,1540,1570
1400 GOSUB1690
1410 PRINT"2":GOSUB1440
1420 FORR=1TODY*2:NEXT:NEXT
1430 RETURN
1440 PRINT"50"
1450 FORK=0TO4:PRINT0$(K)
1460 NEXT:FORK=1TODY*.4:NEXT
1470 RETURN
1480 AN=A1+A2
1490 G$=STR$(A1)+":"+STR$(A2)+":"+STR$(AN)
1500 RETURN
1510 AN=A1
1520 G$=STR$(A1+A2)+":"+STR$(A2)+":"+STR$(AN)
1530 RETURN
1540 AN=A1*A2
1550 G$=STR$(A1)+":"<+STR$(A2)+":">+STR$(AN)
1560 RETURN
1570 AN=A1
1580 G$=STR$(A1*A2)+":"+STR$(A2)+":"+STR$(AN)
1590 RETURN
1600 ONINT(RND(1)*4+1)GOSUB1480,1510,1540,1570
1610 RETURN
1620 M=33168+I*160
1630 B$=RIGHT$(C$,C$(I)+LEFT$(C$,38-C$(I))
1640 FORJ=1TO38
1650 POKEM+J,ASC(MID$(B$,J,1)):NEXT
1660 RETURN
1670 FORI9=0TO14:FORR9=0TO4
1680 READZ$(I9,R9):NEXT:NEXT:RETURN
1690 L9=LEN(G$)
1700 FORI9=1TOL9
1710 A$(I9)=ASC(MID$(G$,I9,1))-48:NEXT
1720 FORR9=0TO4
1730 P$=""
1740 FORI9=1TOL9
1750 IFA$(I9)<0THEN1780
1760 P$=P$+Z$(A$(I9),R9)+""
1770 IFA$(I9)=14THENL$(R9)=LEN(P$)
1780 NEXT
1790 G$(R9)=LEFT$(P$,LEN(P$)-1):NEXT
1800 RETURN
1810 PRINT"
1820 PRINT"
1830 PRINT"
1840 PRINT"
1850 PRINT"
1860 PRINT"
1870 PRINT"
1880 PRINT"
1890 PRINT"
1900 PRINT"
1910 PRINT"
1920 PRINT"
1930 PRINT"

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PROGRAMS

```

1940 PRINT"
1950 PRINT"
1960 PRINT"
1970 PRINT"
1980 PRINT"
1990 PRINT"
2000 PRINT"
2010 PRINT"
2020 PRINT"
2030 PRINT"
2040 PRINT"
2050 RETURN
2060 PRINT"80":FORK=0T04
2070 PRINTD$
2080 NEXT:PRINT"80":RETURN
2090 DATA" ", "001 ", "001 ", "001 ", "001 "
2100 DATA" ", "001 ", "001 ", "001 ", "001 "
2110 DATA" ", "001 ", "001 ", "001 ", "001 "
2120 DATA" ", "001 ", "001 ", "001 ", "001 "
2130 DATA" ", "001 ", "001 ", "001 ", "001 "
2140 DATA" ", "001 ", "001 ", "001 ", "001 "
2150 DATA" ", "001 ", "001 ", "001 ", "001 "
2160 DATA" ", "001 ", "001 ", "001 ", "001 "
2170 DATA" ", "001 ", "001 ", "001 ", "001 "
2180 DATA" ", "001 ", "001 ", "001 ", "001 "
2190 DATA" ", "001 ", "001 ", "001 ", "001 "
2200 DATA" ", "001 ", "001 ", "001 ", "001 "
2210 DATA" ", "001 ", "001 ", "001 ", "001 "
2220 DATA" ", "001 ", "001 ", "001 ", "001 "
2230 DATA" ", "001 ", "001 ", "001 ", "001 "
READY.

```

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able for either buying or selling is dis-
played on the screen. The player enters

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enters the number of shares he wishes
to buy or sell. Providing this is feasible
the program continues with the next
player. The value of the share just
operated on will have either increased
or decreased. Buying a share is more
likely to increase the value and vice
versa.

```

2 RANDOMISE
3 DIM A(12)
4 DIM P(4)
6 FOR I=1 TO 4
8 LET A(I)=100
9 LET P(I)=1000
10 NEXT I
12 FOR J=1 TO 2
14 LET H=RND(4)
16 LET K=J*4+H
18 LET A$=CHR$(32+H*6)
19 CLS
20 PRINT "ELDORADO ",J;" ";P(J)
21 PRINT "
22 PRINT "AVIATION _ GOLD _ MISSILES _ SECRETS"

```

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PROGRAMS

```

24 FOR I=1 TO 12
26 PRINT " ";A(I),
28 IF I=4 THEN PRINT " "
30 NEXT I
34 PRINT "HOLDINGS...";A$;"_BUY/SELL ?"
36 INPUT B$
37 IF B$="Z" THEN STOP
38 IF NOT (B$="B" OR B$="S") THEN GOTO 34
40 PRINT B$;"_HOW MANY ?"
42 INPUT N
44 IF B$="S" THEN GOTO 56
45 IF P(J)< A(H)*N THEN GOTO 40
46 GOSUB 80
54 GOTO 66
56 IF N>A(K) THEN GOTO 40
58 LET N=-N
60 GOSUB 80
64 IF A(H)< 10 THEN LET A(H)=10
66 NEXT J
68 GOTO 12
80 LET P(J)=P(J)-A(H)*N
82 LET A(K)=A(K)+N
84 LET A(H)=A(H)+(RND(50)-10)*N/4
86 RETURN

```

N.B. " " represents one space.

380Z Memory Test

by Graham Allport

```

10 REM PROGRAM TO TEST MEMORY
20 REM GRAHAM ALLPORT
30 REM FEBRUARY 9, 1981
40 CLEAR 500
50 I=1
60 FOR X=1 TO 10:?:NEXT X
70 FOR X=1 TO 5:?:NEXT X
80 ?"MEMORY TRAINING -G.ALLPORT"
90 FOR X=1 TO 10:?:NEXT X
100 ?" CHALLENGER TO ENTER LIST NOW"
110 FOR X=1 TO 8:?:NEXT X
120 ?"WHAT IS THE LIST ABOUT ";
130 INPUT A$
140 ?"HOW MANY TO GIVE ";
150 INPUT A
160 DIM B(A)
170 DIM F(A)
180 FOR X=1 TO A
190 ?"NAME NO ";X;
200 INPUT B(X)
210 NEXT X
220 ?"THANKYOU"
230 FOR X=1 TO 30:?:NEXT X
240 ?" CHALLENGER HAS ENTERED LIST"
250 ?" READY FOR THE OPPONENT"
260 FOR X=1 TO 4:?:NEXT X

```

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PROGRAMS

```

270 ?"NOW FOR THE GAME":?
280 ?"THE SUBJECT LIST IS ";A1:?
290 ?"YOU WILL SEE ";A;" NAMES":?
300 ?"PRESS RETURN WHEN READY":?
310 ?"IF YOU TYPE 'I' AND RETURN"
320 ?"YOU WON'T HAVE TO TYPE IN YOUR ANSWERS":?
330 INPUT Q1
340 FOR X=1 TO 30:NEXTX
350 FOR X=1 TO A
360 G=INT(RND(1)*40)
370 H=INT(RND(1)*30)
380 FOR Y=1 TO 30:?:NEXTY
390 ?TAB(H);B1(X)
400 NEXTX
410 FOR X=1 TO 30:?:NEXTX
420 IF Q1<"I" THEN 540
430 ?"PRESS RETURN FOR CHECK LIST"
440 INPUT Q1
450 ??:?
460 ?"NAMES ENTERED BY CHALLENGER"
470 ?"=====
480 ?"                ON SUBJECT - ";A1
490 ?"                =====
500 FOR X=1 TO A
510 ?B1(X)
520 NEXTX
530 GOTO 860
540 FOR X=1 TO A
550 ?"ANSWER ";X;" PLEASE"
560 INPUT F1(X)
570 FOR Z=1 TO A
580 IF F1(X)<>B1(Z)GOTO 710
590 FOR J=1 TO I
600 IF F1(X)<>G1(J) THEN 650
610 ?"YOU'VE HAD THAT ONE"
620 ?"LOSE ONE POINT"
630 ??:?
640 GOTO 730
650 NEXTJ
660 ?"CORRECT":?:?
670 G1(I)=F1(X)
680 I=I+1
690 S=S+1
700 GOTO 730
710 NEXTZ
720 ?"SORRY - NO":?:?
730 NEXTX
740 FOR Y=1 TO 15:?:NEXTY
750 ?"WELL. THAT'S THE END
760 ?
770 ?"YOUR SCORE IS ";S;" OUT OF ";A
780 ??:?
790 ?"YOUR ANSWERS WERE"
800 ?"=====
810 FOR Y=1 TO A:?:F1(Y):NEXTY
820 ??:?
830 ?"DO YOU WANT A CHECK-LIST -Y/N ";
840 INPUT Q1
850 IF Q1="Y" GOTO 450
860 END
    
```

UP THE SHARP END

Continued from page 97

more, what happens if the engineer is unable to repair a faulty component at site? If fast response was needed in the first place then it is implicit that if a unit cannot be repaired straightaway it must be replaced with a spare, and

allowance for this must be built into the maintenance contract.

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Business micro users can help improve their own lot to a great extent by adopting the local-arrangement philosophy which is already common among large computer users. Very often there will be other organisations in the area using identical hardware or providing identical facilities. Since it is unusual for the small organisation to be using all of its facilities for all of the time, a mutual 'back-scratching' arrangement which takes full advantage of commonalities can work to the benefit of all participants. The maintenance company can do its part in helping this arrangement by advising users of other users with similar installations. Local user clubs can eliminate a lot of headaches.

So, if you are a maintenance com-

pany thinking of offering services in the business-micro field then, as long as the problems are recognised, it is possible to offer good service at acceptable prices and make a fair profit. However, if you try to run micro maintenance as a sideline to your large computer business then it's probable you will end up with a lot of unhappy users and a damaged reputation. There's no room for the half-hearted approach.

If you are a potential user, don't make the mistake of rushing out to your nearest micro-shop with a fistful of pound notes just as soon as your cash situation allows for the capital price of a business micro. The total cost will be significantly more than the capital price, and that's what counts. If you don't recognise this at the start then you might as well donate your cash to the Tooting Popular Front, where at least you'll get a laugh for your money. Power to the People only applies while the equipment is working.

Continued from page 83

```

• 70 GOSUB Z*100
• 80 IF INKEY$ ="5" THEN LET H=H-1
• 90 IF INKEY$ ="8" THEN LET H=H+1
• 91 IF INKEY$ ="6" THEN LET HD=HD+1
• 92 IF HD <> 10 THEN GOTO 35
• 93 IF H=R THEN GOTO 300
• 94 GOSUB 500
• 95 PRINT AT 0,0;"*CRASH LANDING/*"
• 96 STOP
• 100 IF R <> 0 THEN LET R=R-1
• 110 RETURN
• 200 IF R <> 20 THEN LET R=R+1
• 210 RETURN
• 300 GOSUB 500
• 305 PRINT AT 0,0;"*SUCESS*"
• 306 PRINTS;"MINUTES"
• 310 STOP
• 500 CLS
• 510 PRINT AT HD,H;"  "
• 520 PRINT AT 11,R;"  "
• 530 RETURN

```

DOMINOES

Continued from page 101

the user's second free choice move, the program can combine the results of the two sets of calculations by determining the mean probability for each card from the two calculations. The third time the

program would weight the old and new calculations in the ratio of 2:1, to take into account the fact that the old calculations were made on the basis of two moves, while the new ones were made solely on the basis of the last move. The fourth time would see weightings of 3:1 and so on. This level of sophistication would probably produce a program of World Championship calibre!

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Bibliography

Many books provide descriptions of different variants on the game of dominoes. For the serious student I would recommend: Armanino, Dominic C: *Dominoes: Popular Games, Rules & Strategy*, Cornerstone Library, New York, 1977. This book describes the game of 'Five-Up' which is extremely popular in the USA, and it provides material for playing heuristics which can be used in an evaluation function. In closing the present series of articles

I would like to say how much I have enjoyed writing them and I would like to thank the publishers of this magazine for enabling me to enthuse readers with an interest in computer games. I very much hope that many of you have been busily writing your own programs to play games on your personal computers, and that you have had and will have many enjoyable hours of play with your electronic opponent. In the future I shall write occasional articles, whenever I find something to interest you in the field of computer games.

CALCULATOR CORNER

Continued from page 145

comparability. Table 1 shows my results for the 602p compared to *Microcomputing's* figures for the TI59, HP41C and PC1211.

The answer is quite clear; on this test the 602p compares well with any of these machines, its speed and economy of steps compensating for its smaller memory. (Of course, had they tested the HP41-CV the percentage figure would have improved dramatically to percent; however the price is

considerably higher than the 602p's.)

To summarise, then, Casio has come up with another winner, offering staggering value for money in terms of its own model range, let alone its competitors'. Rumour has it that a 702 is planned very shortly, which is a pocket computer using high level language. I feel that Casio was right to build on the success of the 502 before going that route.

Machine	Time taken (secs)	Memory used	% of total Mem.
Texas TI-59	43	59 steps	10.3
Hewlett Packard HP-41C	37	41 bytes	15.6
Sharp PC-1211	51	83 steps	5.9
Casio fx-602p	20	21 steps	4.1

Continued from page 134

```
6805 :  
6810 REM -INITIALISE LINE-  
6820 XL=FALSE:JE=TRUE  
6830 TW=RM-LM+PA*4  
6840 IF DBLE THEN TW=TW/2  
6845 :  
6850 REM -DELETE LEADING SPACES-  
6860 GOSUB 7700  
6870 IF CH#="" AND XT=FALSE THEN 6860  
6880 LP=LP-1:LI#=""  
6885 :  
6890 REM -FETCH LINE-  
6910 GOSUB 7000:IF XL=FALSE THEN 6910  
6920 GOSUB 7200  
6925 :  
6930 IF JU#="Y" AND JE AND CN=0 THEN GOSUB 7300  
6940 IF LEN(LI#)>0 THEN GOSUB 7800  
6950 IF KEV#>"" THEN GOSUB 7600:KEV#=""  
6960 IF LN#EL OR NL=0 THEN 6980  
6970 PRINT#1:NL=NL-1:LN=LN+1:GOTO6960  
6975 :  
6980 IF LN#EL THEN XP=TRUE  
6990 RETURN  
6995 :  
7000 REM ** EXTEND LINE **  
7010 GOSUB 7700  
7020 IF CH#<>" " THEN 7120  
7025 :  
7030 REM -FETCH KEY & KEYVALUE-  
7040 KU=0:KS=1  
7050 GOSUB 7700:KEV#CH#  
7060 IF KEV#<>"T" THEN XL=TRUE:JE=FALSE  
7070 GOSUB 7700  
7075 :  
7080 IF CH#="" THEN KS=-1:GOSUB 7700  
7085 IF CH#="" THEN GOSUB 7700
```

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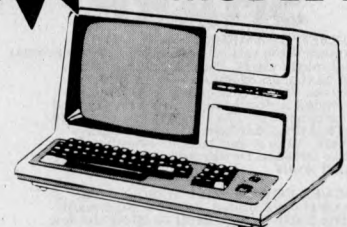
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```

7086 :
7090 IF CH$="9" OR CH$="0" THEN 7110
7100 KUL=KUL+10+VAL(CH$):GOSUB 7700: GOTO 7090
7110 KU=KS*KU:GOTO7140
7115 :
7120 REM -APPEND CHAR-
7130 LI$=LI$+CH$:IF LEN(LI$)>TW THEN XL=TRUE:GOSUB 7700
7135 :
7140 IF KEY$<>"T" THEN RETURN
7145 :
7150 REM -PRINT TAB-
7160 IF XL=TRUE OR LEN(LI$)>=KUL-1 THEN7190
7170 LI$=LI$+" ":IF LEN(LI$)>TW THEN XL=TRUE.
7180 GOTO 7160
7190 KEY$="" :RETURN
7195 :
7200 REM ** CUT LINE **
7205 :
7210 LL=LEN(LI$):LTEMP=LP
7220 FOR N=LLTO1 STEP-1
7230 IF CH$=" " OR CH$="J" THEN LL=N:LT=LP:N=1:GOTO 7260
7240 LP=LP-2:GOSUB 7700
7250 IF CH$="-" THEN LL=N:LT=LP:N=1
7260 NEXT N
7270 LI$=LEFT$(LI$,LL):LP=LT:RETURN
7275 :
7300 REM ** JUSTIFY LINE **
7305 :
7310 REM -ANY SPACES?-
7320 SP=FALSE: FOR N=1 TO LL
7330 IF MID$(LI$,N,1)=" " THEN SP=TRUE:N=LL
7340 NEXT N
7350 IF LEN(LI$)>TW OR NOT SP THEN RETURN
7355 :
7360 REM -FIND A SPACE-
7370 SL=SL+1:IF SL>LEN(LI$)THEN SL=2
7380 IF MID$(LI$,SL,1)<>" " THEN 7370
7385 :
7390 LI$=LEFT$(LI$,SL)+" "+MID$(LI$,SL+1)
7395 :
7400 REM -FIND A CHARACTER-
7410 SL=SL+1:IF SL>LEN(LI$)THEN SL=2
7420 IF MID$(LI$,SL,1)=" " THEN 7410
7430 GOTO 7350
7435 :
7600 REM ** UPDATE STATUS **
7610 IF KEY$="N" THEN NL=KU:RETURN
7620 IF KEY$="F" THEN NL=BL-LN+1:RETURN
7630 IF KEY$="D" THEN DB=NOT DB:RETURN
7640 IF KEY$="C" THEN CN=NOT CN:RETURN
7650 IF KEY$="L" THEN LM=LM+KU:RETURN
7660 IF KEY$="R" THEN RM=RM+KU:RETURN
7670 IF KEY$="P" THEN PA=TRUE:NL=1:RETURN
7675 :
7680 PRINT"UNKNOWN KEY" = " :KEY$
7690 XP=TRUE:XT=TRUE:RETURN
7695 :
7700 REM ** GET NEXT CHAR FROM MEM **
7710 CH=PEEK(LP):LP=LP+1
7720 IF LP>TF THEN XL=TRUE:XP=TRUE:XT=TRUE:JE=FALSE
7730 GOSUB 9250:CH$=CHR$(CH)
7740 RETURN
7745 :
7800 REM ** PRINT LINE **
7810 IF DB THEN 7870
7815 :
7820 REM -SINGLE WIDTH-
7830 IF NOT CN THEN MM=(LM-4*PA)/2
7840 IF CN THEN MM=(LM+TW-LEN(LI$))/2
7845 IF MM<0 THEN MM=0
7846 :
7850 IF FL=4 THEN 8000
7860 PRINT#1,SPC(MM):LI$:GOTO8090
7865 :
7870 REM -DOUBLE WIDTH-
7880 IF NOT CN THEN MM=(LM-4*PA)/2
7890 IF CN THEN MM=(LM+TW-LEN(LI$))/2
7895 IF MM<0 THEN MM=0
7896 :
7900 IF FL=4 THEN 8000
7910 PRINT#1,SPC(MM*2);
7920 FOR N=1 TO LEN(LI$)
7930 PRINT#1,MID$(LI$,N,1);" ";
7940 NEXT N:GOTO8090
7945 :
8000 REM -OUTPUT TO EPSON PRINTER-
8010 IF DB THEN PRINT#1,CHR$(1);
8015 PRINT#1,SPC(MM*5);
8020 FOR N=1 TO LEN(LI$)
8030 CH=ASC(MID$(LI$,N,1))
8040 CMSB=CH AND 192:CH=CH AND 31
8045 :
8050 ON CMSB/64 GOTO 8060,8065,8070
8055 CH=CH OR 32 :GOTO 8080
8060 CH=CH OR 96 :GOTO 8080
8065 CH=CH OR 160:GOTO 8080
8070 CH=CH OR 64
8075 :
8080 PRINT#1,CHR$(CH):NEXT N
8085 :

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8090 PRINT#1:LN=LN+1
8100 PA=FALSE
8110 RETURN
8115 :
9000 REM ** FLASH CURSOR & GET CH **
9010 TEMP=PEEK(CP)
9020 POKE CP,160
9030 FOR AGES=1 TO 10:NEXT
9040 POKE CP,TEMP
9050 FOR AGES=1 TO 10:NEXT
9055 :
9060 GET CH:IF CH="" THEN 9020
9070 CH=ASC(CH):RETURN
9075 :
9100 REM ** CURSOR CONTROL **
9105 CC=FALSE
9110 IF CH<22 OR (CH>95 AND CH<160) THEN CC=TRUE
9115 IF CH="" THEN CP=CP+1:DP=DP+1:GOTO 9150
9120 IF CH="" THEN CP=CP-1:DP=DP-1:GOTO 9150
9125 IF CH="" THEN CP=CP+40:DP=DP+40:GOTO 9150
9130 IF CH="" THEN CP=CP-40:DP=DP-40:GOTO 9150
9135 IF CH="" THEN DP=DP-(CP-HOME):CP=HOME:GOTO 9150
9140 IF CH="" THEN DP=DP+(AWAY-CP):CP=AWAY
9150 IF CP<HO THEN GOSUB 4300
9160 IF CP>HW THEN GOSUB 4200
9170 IF DP>TP THEN CP=CP+(TF-DP):DP=TP
9180 RETURN
9185 :
9250 REM ** SCREEN TO ASCII **
9260 CMB=CH AND 96:CH=CH AND 31
9270 ON CMB/32 GOTO 9280,9285,9290
9275 CH=CH OR 64:RETURN
9280 CH=CH OR 32:RETURN
9285 CH=CH OR 192:RETURN
9290 CH=CH OR 160:RETURN
9295 :
9300 REM ** M/C COPY UP **
9310 ADR=SART:DAT=S:GOSUB 9800
9320 ADR=FINI:DAT=F:GOSUB 9800
9330 ADR=DEST:DAT=D:GOSUB 9800
9340 SVS 895:RETURN
9345 :
9350 REM ** M/C COPY DOWN **
9360 ADR=SART:DAT=S:GOSUB 9800
9370 ADR=FINI:DAT=F:GOSUB 9800
9380 ADR=DEST:DAT=D:GOSUB 9800
9390 SVS 855:RETURN
9395 :
9800 REM ** DOUBLEBYTE POKE **
9810 DH=INT(DAT/256)
9820 DL=INT(DAT-DH*256)
9830 POKE ADR,DL:POKE ADR+1,DH
9840 RETURN
9850 :
9900 REM ** M/C LOADER **
9910 FOR ADR=832 TO 940
9920 READ DAT:POKE ADR,DAT
9930 NEXT:RETURN
9935 :
10000 REM ** M/C COPY ROUTINES **
10005 DATA 173,58,3,133,102,173,59,3
10010 DATA 133,103,173,62,3,133,104
10015 DATA 173,63,3,133,105,162,0,96
10020 :
10025 DATA 32,64,3,165,103,205,61,3
10030 DATA 144,11,240,1,96,165,102
10035 DATA 205,60,3,144,1,96,161,102
10040 DATA 129,104,230,102,208,2
10045 DATA 230,103,230,104,208,2
10050 DATA 230,105,76,90,3
10055 :
10060 DATA 32,64,3,165,103,205,61,3
10065 DATA 240,3,176,9,96,165,102
10070 DATA 205,60,3,176,1,96,161,102
10075 DATA 41,127,129,104,165,102,208,2
10080 DATA 198,103,198,102,165,104
10085 DATA 208,2,198,105,198,104
10090 DATA 76,130,3

```

BLUDNERS

Gulp! Page 73 of last month's issue somehow acquired an ad instead of 'Calculator Corner'. Next month we'll try again.

See the 'Communications' pages for the solution to July's ZX81 'Sketchpad' mess-up.

We've even managed to spot an error in this month's issue — page 156 (Net-work News). Frederick Brown's 'phone number is 0482 859169. We apologise to the little old lady in Hull who's been getting his calls.

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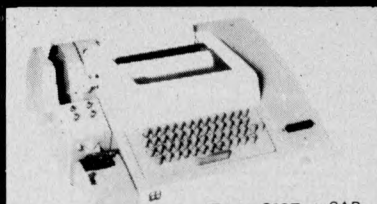
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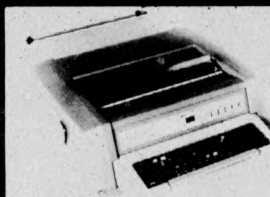
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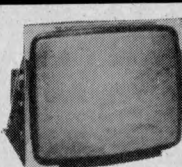


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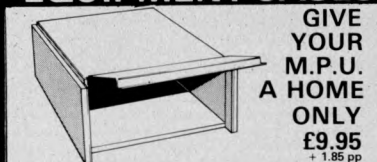
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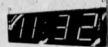


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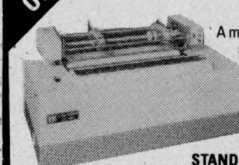
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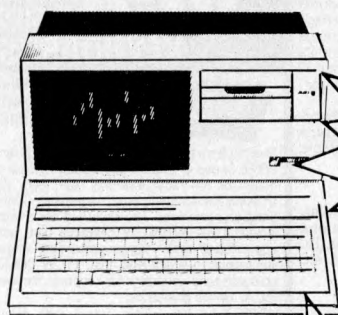
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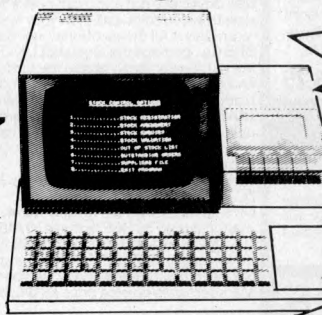


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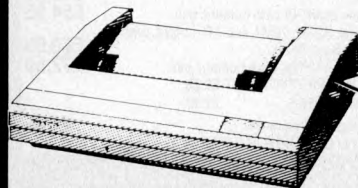
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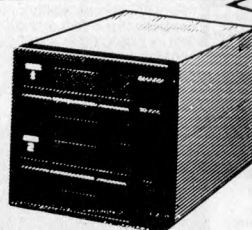
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1702	325	7425	20 <td>LS04</td> <td>15<td>LS347</td><td>190</td><td>100KHz</td><td>290</td></td>	LS04	15 <td>LS347</td> <td>190</td> <td>100KHz</td> <td>290</td>	LS347	190	100KHz	290
1802	720	7426	30 <td>LS05</td> <td>15<td>LS348</td><td>185</td><td>200KHz</td><td>370</td></td>	LS05	15 <td>LS348</td> <td>185</td> <td>200KHz</td> <td>370</td>	LS348	185	200KHz	370
2101.2	250	7427	27	LS06	15 <td>LS352</td> <td>185</td> <td>455KHz</td> <td>383</td>	LS352	185	455KHz	383
2112.2	250	7428	28 <td>LS08</td> <td>15<td>LS353</td><td>37</td><td>1.0MHz</td><td>300</td></td>	LS08	15 <td>LS353</td> <td>37</td> <td>1.0MHz</td> <td>300</td>	LS353	37	1.0MHz	300
2114.450n	99	7430	16 <td>LS09</td> <td>15<td>LS365</td><td>37</td><td>1.008MHz</td><td>395</td></td>	LS09	15 <td>LS365</td> <td>37</td> <td>1.008MHz</td> <td>395</td>	LS365	37	1.008MHz	395
2114.300n	99	7432	26 <td>LS11</td> <td>15<td>LS367</td><td>90</td><td>1.28MHz</td><td>392</td></td>	LS11	15 <td>LS367</td> <td>90</td> <td>1.28MHz</td> <td>392</td>	LS367	90	1.28MHz	392
2154.200n	130	7433	27 <td>LS12</td> <td>15<td>LS368</td><td>75</td><td>1.6MHz</td><td>323</td></td>	LS12	15 <td>LS368</td> <td>75</td> <td>1.6MHz</td> <td>323</td>	LS368	75	1.6MHz	323
2532.450n	720	7437	27 <td>LS13</td> <td>30<td>LS373</td><td>75</td><td>1.8MHz</td><td>323</td></td>	LS13	30 <td>LS373</td> <td>75</td> <td>1.8MHz</td> <td>323</td>	LS373	75	1.8MHz	323
2708	225	7438	17 <td>LS14</td> <td>48<td>LS374</td><td>48</td><td>1.8MHz</td><td>323</td></td>	LS14	48 <td>LS374</td> <td>48</td> <td>1.8MHz</td> <td>323</td>	LS374	48	1.8MHz	323
2716.5V	250	7440	17 <td>LS15</td> <td>15<td>LS375</td><td>90</td><td>1.8432MHz</td><td>300</td></td>	LS15	15 <td>LS375</td> <td>90</td> <td>1.8432MHz</td> <td>300</td>	LS375	90	1.8432MHz	300
2732.450n	720	7441	68	LS20	15 <td>LS377</td> <td>69</td> <td>2.0MHz</td> <td>305</td>	LS377	69	2.0MHz	305
4027	240	7442	38	LS21	15 <td>LS378</td> <td>69</td> <td>2.4576MHz</td> <td>300</td>	LS378	69	2.4576MHz	300
4116	99	7443	90	LS22	15 <td>LS379</td> <td>250</td> <td>3.2768MHz</td> <td>300</td>	LS379	250	3.2768MHz	300
4118	530	7444	90	LS26	15 <td>LS384</td> <td>250</td> <td>3.57954M</td> <td>195</td>	LS384	250	3.57954M	195
4315CMOS	995	7445	65	LS27	15 <td>LS385</td> <td>378</td> <td>3.6864M</td> <td>300</td>	LS385	378	3.6864M	300
6116	11	7446	55	LS28	20 <td>LS386</td> <td>28</td> <td>4.0MHz</td> <td>290</td>	LS386	28	4.0MHz	290
6502CPU	495	7447	50 <td>LS30</td> <td>18<td>LS390</td><td>62</td><td>4.032MHz</td><td>323</td></td>	LS30	18 <td>LS390</td> <td>62</td> <td>4.032MHz</td> <td>323</td>	LS390	62	4.032MHz	323
6503	850	7448	50 <td>LS32</td> <td>15<td>LS393</td><td>60</td><td>4.19430M</td><td>270</td></td>	LS32	15 <td>LS393</td> <td>60</td> <td>4.19430M</td> <td>270</td>	LS393	60	4.19430M	270
6505	795	7472	30 <td>LS33</td> <td>16<td>LS396</td><td>190</td><td>4.433619M</td><td>135</td></td>	LS33	16 <td>LS396</td> <td>190</td> <td>4.433619M</td> <td>135</td>	LS396	190	4.433619M	135
6520PIA	325	7473	30 <td>LS36</td> <td>16<td>LS398</td><td>275</td><td>5.0MHz</td><td>300</td></td>	LS36	16 <td>LS398</td> <td>275</td> <td>5.0MHz</td> <td>300</td>	LS398	275	5.0MHz	300
6522VIA	570	7474	25 <td>LS38</td> <td>16<td>LS440</td><td>245</td><td>5.185MHz</td><td>323</td></td>	LS38	16 <td>LS440</td> <td>245</td> <td>5.185MHz</td> <td>323</td>	LS440	245	5.185MHz	323
6530ARIOT	1350	7475	40 <td>LS40</td> <td>16<td>LS447</td><td>195</td><td>5.24288M</td><td>425</td></td>	LS40	16 <td>LS447</td> <td>195</td> <td>5.24288M</td> <td>425</td>	LS447	195	5.24288M	425
6532RIOT	795	7476	30 <td>LS42</td> <td>35<td>LS471</td><td>620</td><td>6.0MHz</td><td>300</td></td>	LS42	35 <td>LS471</td> <td>620</td> <td>6.0MHz</td> <td>300</td>	LS471	620	6.0MHz	300
6545CRTC	1450	7480	48 <td>LS47</td> <td>40<td>LS490</td><td>245</td><td>6.144MHz</td><td>295</td></td>	LS47	40 <td>LS490</td> <td>245</td> <td>6.144MHz</td> <td>295</td>	LS490	245	6.144MHz	295
6551ACIA	785	7481	120	LS48	80 <td>LS541</td> <td>135</td> <td>6.5536MHz</td> <td>290</td>	LS541	135	6.5536MHz	290
6592PC	£27	7484	80 <td>LS49</td> <td>60<td>LS571</td><td>620</td><td>7.0MHz</td><td>290</td></td>	LS49	60 <td>LS571</td> <td>620</td> <td>7.0MHz</td> <td>290</td>	LS571	620	7.0MHz	290
6800	375	7485	95	LS51	15 <td>LS668</td> <td>175</td> <td>7.680MHz</td> <td>323</td>	LS668	175	7.680MHz	323
6802	1395	7486	26 <td>LS54</td> <td>15<td>LS669</td><td>150</td><td>8.0MHz</td><td>300</td></td>	LS54	15 <td>LS669</td> <td>150</td> <td>8.0MHz</td> <td>300</td>	LS669	150	8.0MHz	300
6810	175	7489	205	LS55	30 <td>LS670</td> <td>175</td> <td>8.08333M</td> <td>362</td>	LS670	175	8.08333M	362
6821	175	7490	28 <td>LS56</td> <td>150<td>LS673</td><td>550</td><td>8.867237M</td><td>300</td></td>	LS56	150 <td>LS673</td> <td>550</td> <td>8.867237M</td> <td>300</td>	LS673	550	8.867237M	300
6821	175	7492	30 <td>LS57</td> <td>25<td>LS674</td><td>750</td><td>9.375MHz</td><td>323</td></td>	LS57	25 <td>LS674</td> <td>750</td> <td>9.375MHz</td> <td>323</td>	LS674	750	9.375MHz	323
6840	470	7493	30 <td>LS74</td> <td>25<td></td><td></td><td>10.0MHz</td><td>300</td></td>	LS74	25 <td></td> <td></td> <td>10.0MHz</td> <td>300</td>			10.0MHz	300
6843	1459	74100	85	LS75	28 <td></td> <td></td> <td>10.7MHz</td> <td>300</td>			10.7MHz	300
6845	975	74110	40 <td>LS76</td> <td>20<td></td><td></td><td>12.0MHz</td><td>392</td></td>	LS76	20 <td></td> <td></td> <td>12.0MHz</td> <td>392</td>			12.0MHz	392
6847	795	74111	55 <td>LS78</td> <td>24<td></td><td></td><td>12.1818M</td><td>362</td></td>	LS78	24 <td></td> <td></td> <td>12.1818M</td> <td>362</td>			12.1818M	362
6850	175	74112	170	LS83	50 <td></td> <td></td> <td>16.0MHz</td> <td>290</td>			16.0MHz	290
6852	370	74116	88	LS85	70 <td></td> <td></td> <td>18.0MHz</td> <td>323</td>			18.0MHz	323
8080A	450	74118	80 <td>LS86</td> <td>38<td></td><td></td><td>18.432M</td><td>323</td></td>	LS86	38 <td></td> <td></td> <td>18.432M</td> <td>323</td>			18.432M	323
8085A	99	74119	90 <td>LS90</td> <td>35<td></td><td></td><td>19.968MHz</td><td>300</td></td>	LS90	35 <td></td> <td></td> <td>19.968MHz</td> <td>300</td>			19.968MHz	300
81LS95	99	74120	75 <td>LS91</td> <td>80</td> <td>74L00</td> <td>74L</td> <td>20.0MHz</td> <td>323</td>	LS91	80	74L00	74L	20.0MHz	323
81LS96	99	74121	30 <td>LS92</td> <td>36</td> <td>74L30</td> <td>190</td> <td>26.0MHz</td> <td>290</td>	LS92	36	74L30	190	26.0MHz	290
8212	210	74122	45 <td>LS93</td> <td>36</td> <td>74L47</td> <td>380</td> <td>27.145MHz</td> <td>300</td>	LS93	36	74L47	380	27.145MHz	300
8214	425	74123	50 <td>LS95</td> <td>45</td> <td>74L75</td> <td>145</td> <td>27.648MHz</td> <td>323</td>	LS95	45	74L75	145	27.648MHz	323
8216	200	74125	42 <td>LS96</td> <td>120</td> <td>74L85</td> <td>349</td> <td>38.6667M</td> <td>350</td>	LS96	120	74L85	349	38.6667M	350
8251	400	74126	40 <td>LS107</td> <td>43</td> <td>74L121</td> <td>165</td> <td>48.0MHz</td> <td>323</td>	LS107	43	74L121	165	48.0MHz	323
8253	799	74132	48	LS109	30	74L123	325	100.0MHz	323
8255	399	74136	35 <td>LS113</td> <td>40</td> <td></td> <td></td> <td>116.0MHz</td> <td>300</td>	LS113	40			116.0MHz	300
8257	800	74143	250	LS114	35				
8T26A	90	74144	250	LS122	44	74500	60		
8T28A	90	74145	70	LS122	44	74504	73		
8T31A	350	74147	99	LS123	55	74512	138		
8T35N	160	74148	75	LS124	105	74513	240		
8T37N	90	74150	80	LS126	30	74518	158		
AY-3-1015	395	74151	45	LS126	30	74519	390		
AY-5-1013	700	74153	45	LS132	45	745201	840		
AY-5-2376	750	74154	75	LS133	35	745262	550		
MC1488	75	74155	75	LS136	28	745267	325		
MC1489	75	74156	75	LS138	35	745288	210		
MC14411	695	74157	45	LS139	38	745301	325		
MC14412	800	74159	99	LS145	75	745472	1150		
RO-3-2513U	600	74160	60	LS147	199	745475	825		
RO-3-2513L	850	74161	60	LS148	99	745521	620		
SFF96364E	950	74162	62	LS151	39				
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SFC71301	820	74164	64	LS155	39				
TMS2716-3V	1050	74165	62	LS156	39				
TMS4027	240	74166	65	LS157	35				
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		74199	99	LS240	165				
		74201	80	LS241	96				
		74202	150	LS242	85				
		74203	150	LS243	85				
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		74232	100	LS308	330				
		74233	100	LS309	330				
		74234	100	LS310	330				
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		74254	100	LS330	330				
		74255	100	LS331	330				
		74256	100	LS332	330				
		74257	100	LS333	330				
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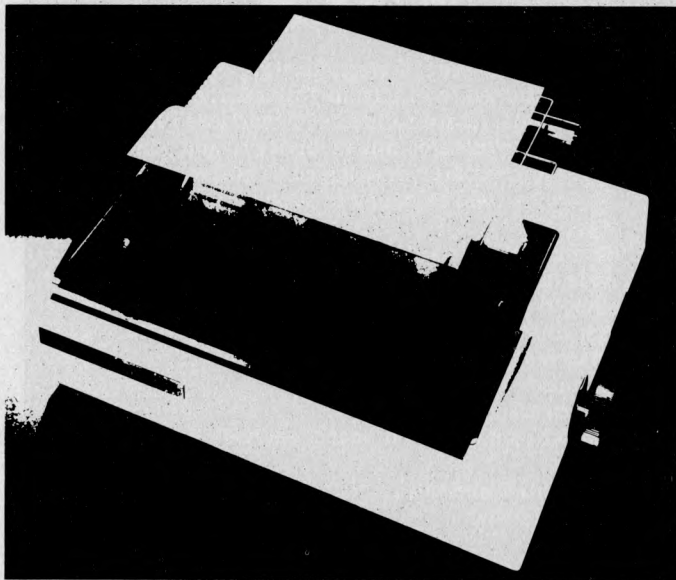


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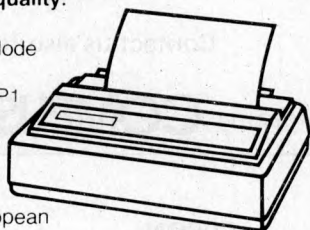
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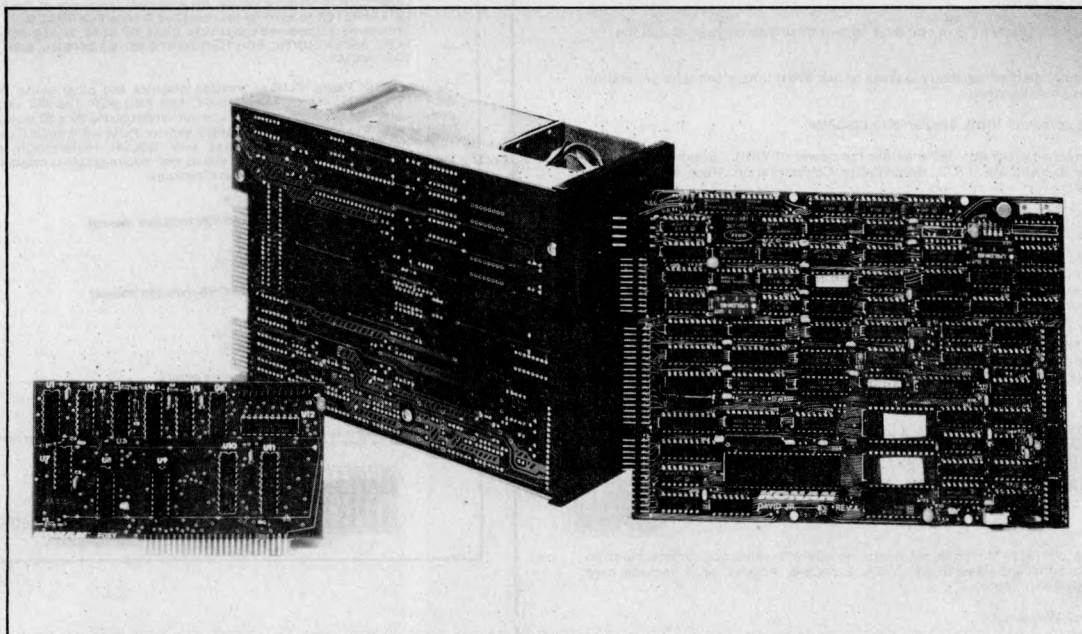


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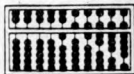


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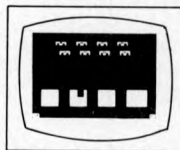
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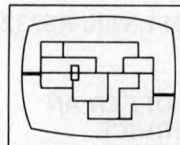


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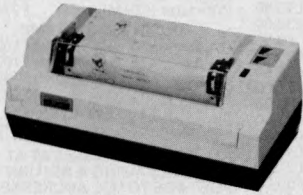
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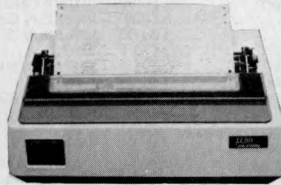


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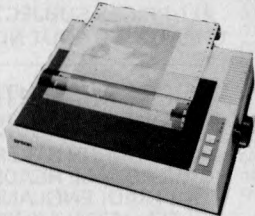


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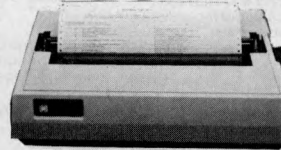
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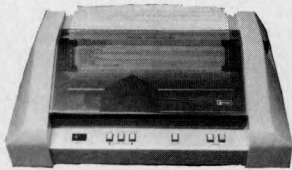


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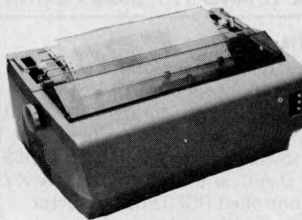
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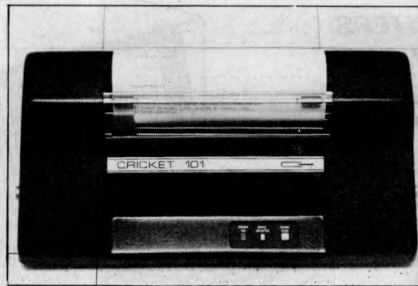
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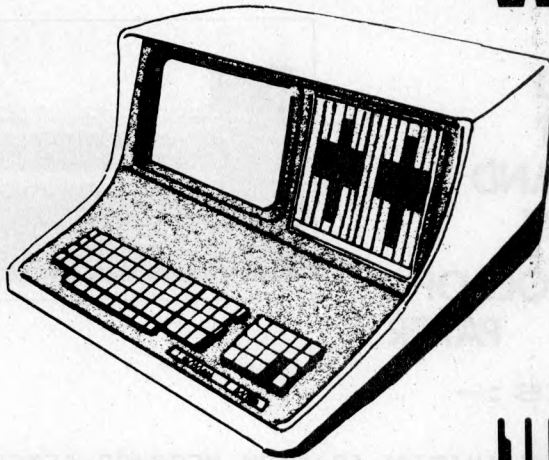
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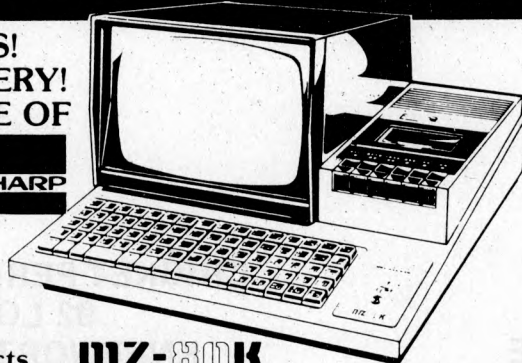
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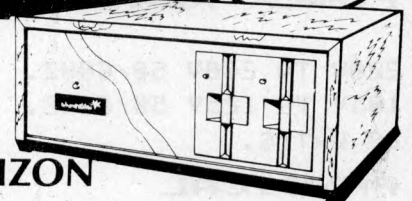
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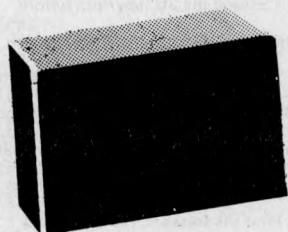
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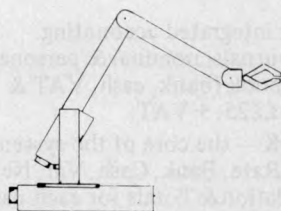
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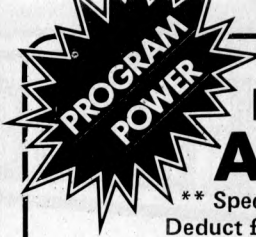
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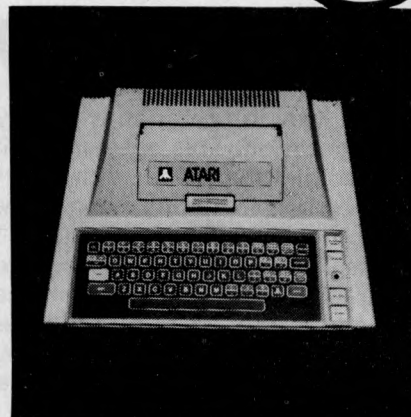
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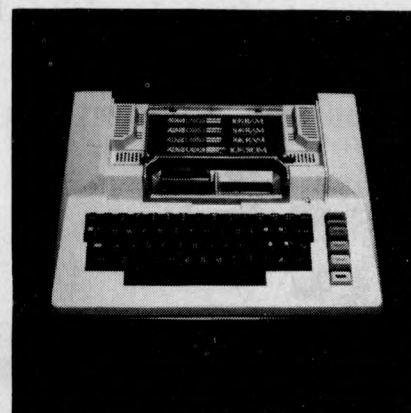
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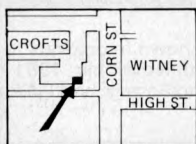
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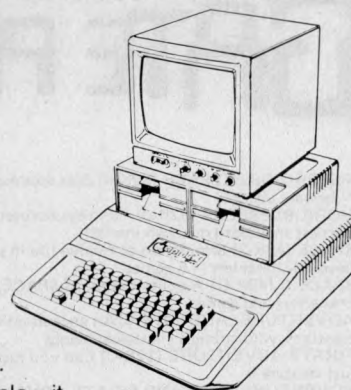
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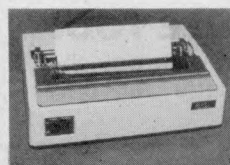
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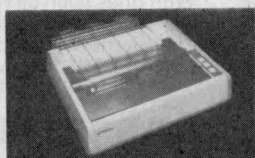
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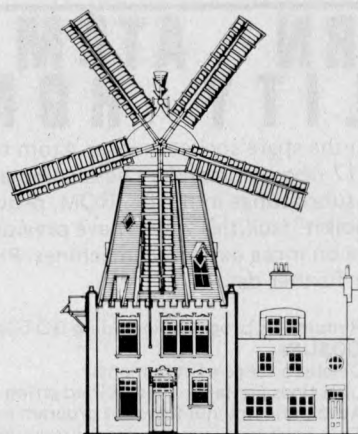
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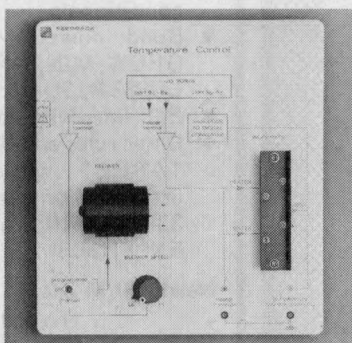
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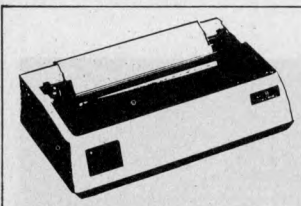


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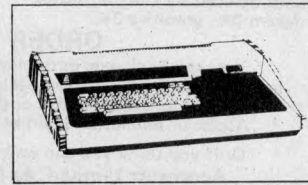
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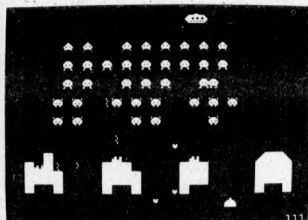
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Dogfight Two-player game each player controls a plane and tries to shoot down his opponent without crashing. Program 4K, graphics 6K.

Mastermind Guess the computer's code before the computer guesses yours; program 3K, graphics ½K.

Zombie Land on Zombie island; try to lure all the zombies into the swamp. In desperation jump into hyper-space! Program 3K, graphics ½K. COLOUR

GAMES PACK 4

Star Trek Classic computer game, rid the universe of Klingons. Short and long-range scans, galactic map, phasers, photon torpedoes, shields, etc. Program 5K, graphics 2K.

Four Row Take turns in placing marbles on the board; the first to get a line of four wins. Program 5K, graphics 6K.

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Space Attack Repel the invasions of earth and avoid being hit by the gunner ships. Becomes progressively harder with each invasion. Program 3K, graphics 6K.

GAMES PACK 6

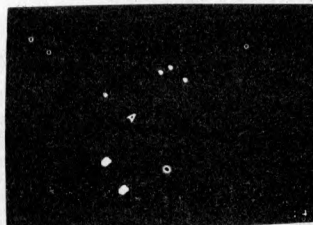
Dodgems Steer your car and avoid the computer-controlled car programmed to collide. Survive, and the game gets faster. Program 4K, graphics 6K.

Simon Test your ability to remember a progressively longer sequence of lights and tones. Adjustable skill level. Program 2K, graphics 3K. COLOUR

Amoeba Try and create the shapes devised by the computer. Program 3K, graphics 3K.

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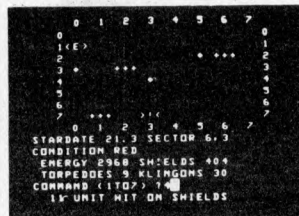


GAMES PACK 3

Rat Trap Move your rats without colliding with the trails left. Entangle your opponent before he entangles you! High-speed rat action-replay. Program 4K, graphics 6K.

Lunar Lander Land a spacecraft on a lunar crater; altitude velocity, fuel and drift. Program 1K, graphics ½K.

Black Box Deduce the position of four invisible objects in the Black Box by firing rays at them. Program 4K, graphics ½K.



GAMES PACK 7

Green Things An alien life-form has invaded your spacecraft; discover a way of destroying it with the weapons available on the ship. Program 5K, graphics 2K. COLOUR

Ballistics Take turns in firing shells at the other player, taking into account the wind and shape of the hill. Program 3K, graphics 6K, needs floating-point.

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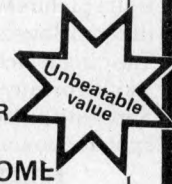


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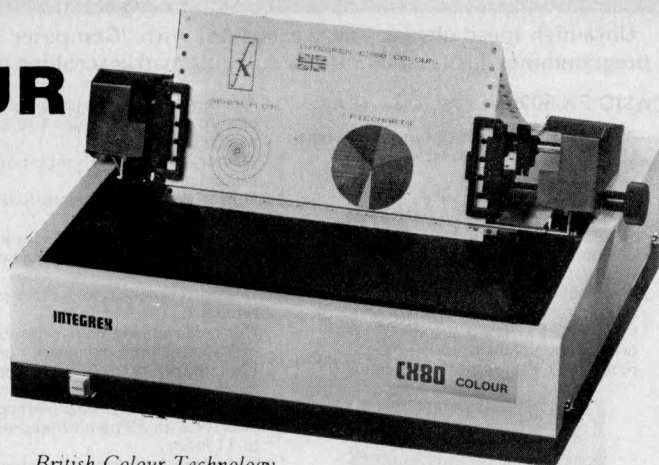


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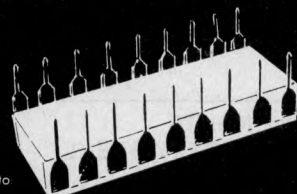
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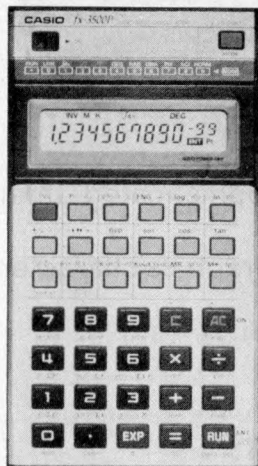
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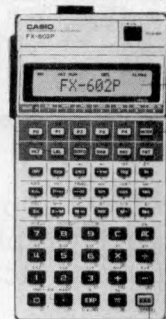
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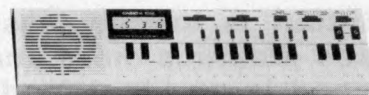
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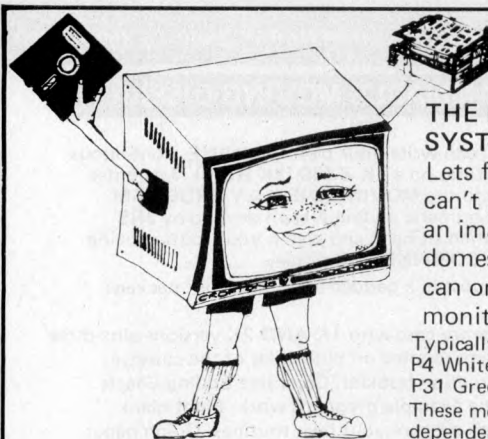
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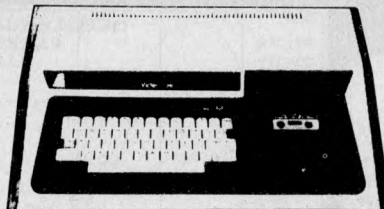
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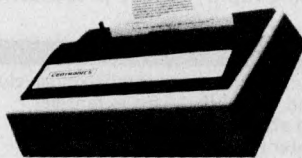
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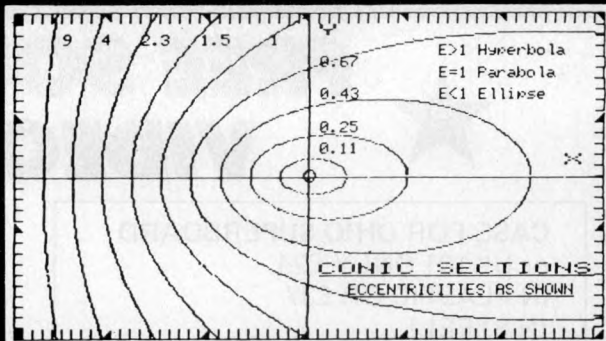
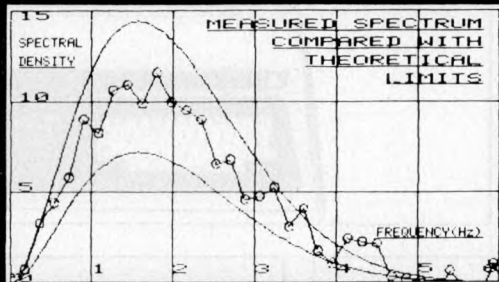


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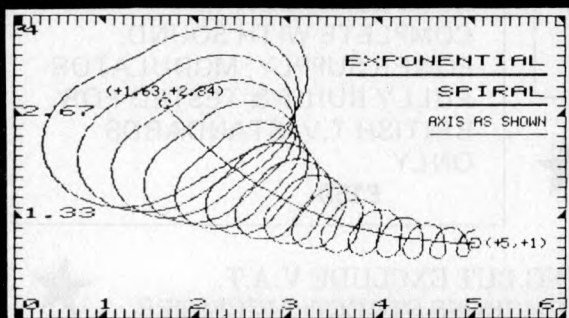
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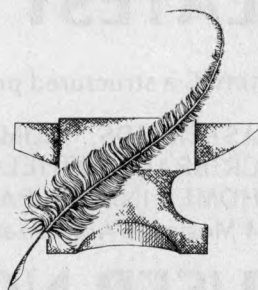
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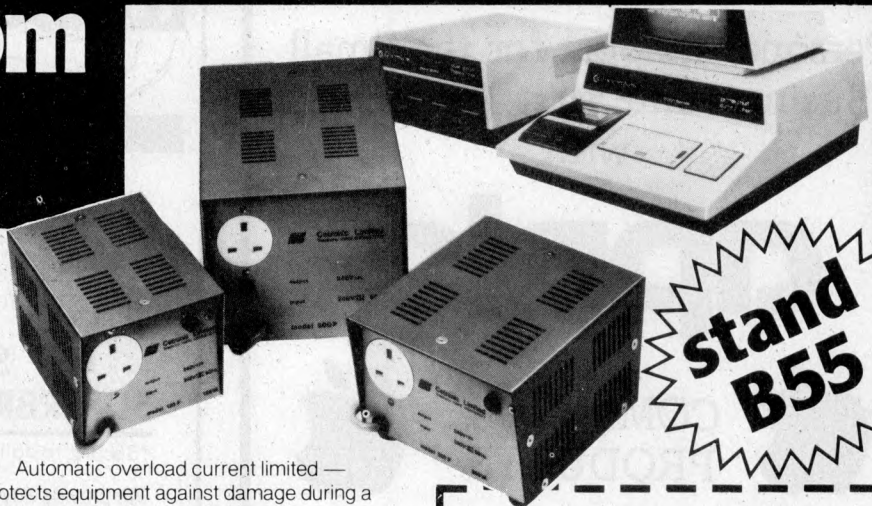
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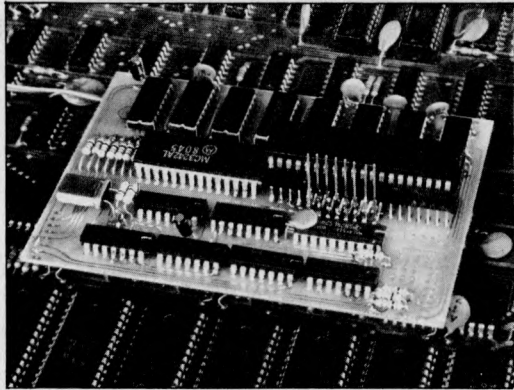
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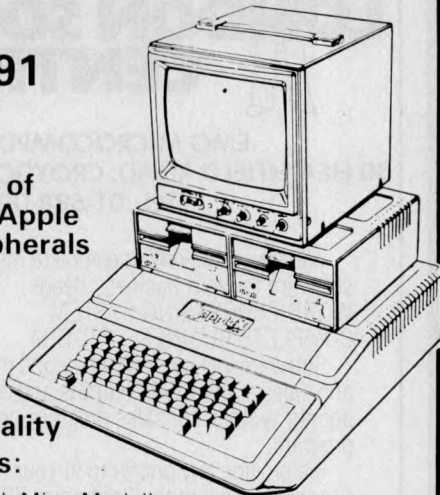
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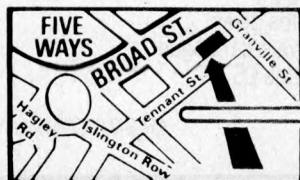
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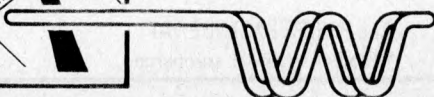
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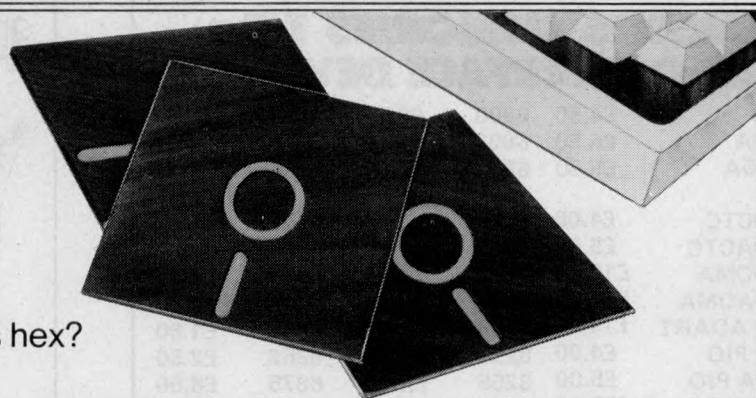
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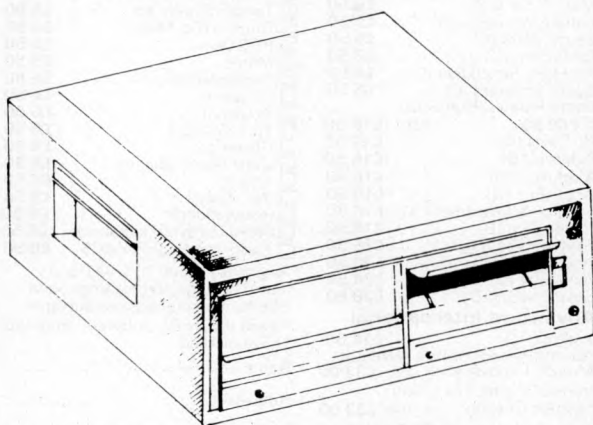
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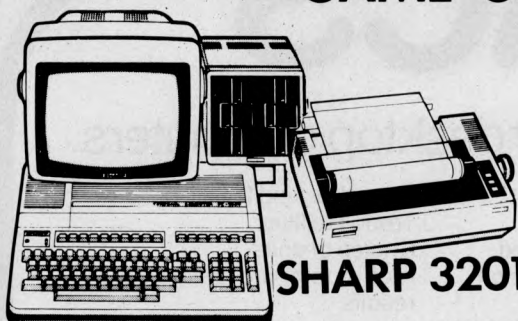
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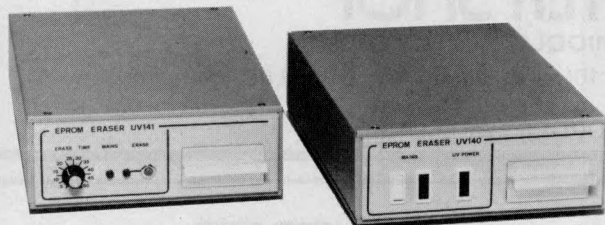
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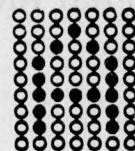
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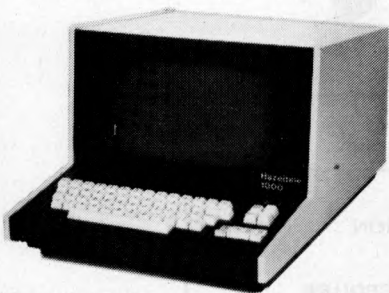
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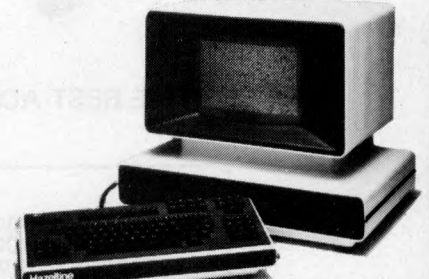
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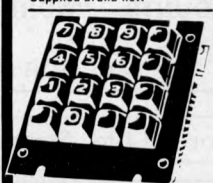
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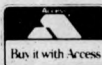
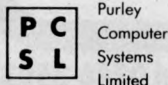
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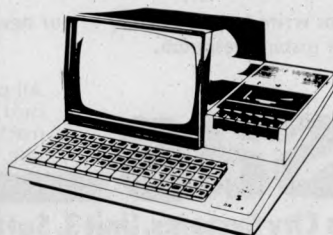
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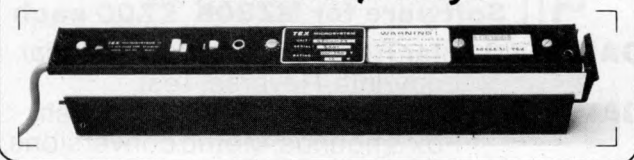
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SYNC magazine is different from other personal computing magazines. Not just different because it is about a unique computer, the Sinclair ZX80 (and kit version, the MicroAce). But different because of the creative and innovative philosophy of the editors.

A Fascinating Computer

The ZX80 doesn't have memory mapped video. Thus the screen goes blank when a key is pressed. To some reviewers this is a disadvantage. To our editors this is a challenge. One suggested that games could be written to take advantage of the screen blanking. For example, how about a game where characters and graphic symbols move around the screen while it is blanked? The object would be to crack the secret code governing the movements. Voila! A new game like Mastermind or Black Box uniquely for the ZX80.

We made some interesting discoveries soon after setting up the machine. For instance, the CHR\$ function is not limited to a value between 0 and 255, but cycles repeatedly through the code. CHR\$ (9) and CHR\$ (265) will produce identical values. In other words, CHR\$ operates in a MOD 256 fashion. We found that the "=" sign can be used several times on a single line, allowing the logical evaluation of variables. In the Sinclair, LET X=Y=Z=W is a valid expression.

Or consider the TL\$ function which strips a string of its initial character. At first, we wondered what practical value it had. Then someone suggested it would be perfect for removing the dollar sign from numerical inputs.

Breakthroughs? Hardly. But indicative of the hints and kinds you'll find in every issue of SYNC. We intend to take the Sinclair to its limits and then push beyond, finding new tricks and tips, new applications, new ways to do what couldn't be done before. SYNC functions

on many levels, with tutorials for the beginner and concepts that will keep the pros coming back for more. We'll show you how to duplicate commands available in other Basics. And, perhaps, how to do things that can't be done on other machines.

Many computer applications require that data be sorted. But did you realize there are over ten fundamentally different sorting algorithms? Many people settle for a simple bubble sort perhaps because it's described in so many programming manuals or because they've seen it in another program. However, sort routines such as heapsort or Shell-Metzner are over 100 times as fast as a bubble sort and may actually use less memory. Sure, 1K of memory isn't a lot to work with, but it can be stretched much further by using innovative, clever coding. You'll find this type of help in SYNC.

Lots of Games and Applications

Applications and software are the meat of SYNC. We recognize that along with useful, pragmatic applications, like financial analysis and graphing, you'll want games that are fun and challenging. In the charter issue of SYNC you'll find several games. Acey Ducey is a card game in which the dealer (the computer) deals two cards face up. You then have an option to bet depending upon whether you feel the next card dealt will have a value between the first two.

In Hurdle, another game in the charter issue, you have to find a happy little Hurdle who is hiding on a 10 X 10 grid. In response to your guesses, the Hurdle sends out a clue telling you in which direction to look next.

One of the most ancient forms of arithmetical puzzle is called a "boomerang." The oldest recorded example is that set down by Nicomachus in his *Arithmetica* around 100 A.D. You'll find a computer version of this puzzle in SYNC.

Hard-Hitting, Objective Evaluations

By selecting the ZX80 or MicroAce as your personal computer you've shown that you are an astute buyer looking for good performance, an innovative design and economical price. However, selecting software will not be easy. That's where SYNC comes in. SYNC evaluates software packages and other peripherals and doesn't just publish manufacturer descriptions. We put each package through its paces and give you an in-depth, objective report of its strengths and weaknesses.

SYNC is a Creative Computing publication. Creative Computing is the number 1 magazine of software and applications with nearly 100,000 circulation. The two most popular computer games books in the world, *Basic Computer Games* and *More Basic Computer Games* (combined sales over 500,000) are published by Creative Computing. Creative Computing Software manufactures over 150 software packages for six different personal computers.

Creative Computing, founded in 1974 by David Ahl, is a well-established firm committed to the future of personal computing. We expect the Sinclair ZX80 to be a highly successful computer and correspondingly, SYNC to be a respected and successful magazine.

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Needless to say, we can't fill up all the pages without your help. So send in your programs, articles, hints and tips. Remember, illustrations and screen photos make a piece much more interesting. Send in your reviews of peripherals and software too—but be warned: reviews must be in-depth and objective. We want you to respect what you read on the pages of SYNC so be honest and forthright in the material you send us. Of course we pay for contributions—just don't expect to retire on it.

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The magazine for Sinclair ZX80 users

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ChipChat

Ever wondered how Uncle Clive Sinclair keeps track of the money that's pouring in from all those thousands of ZX81s being sold? With VisiCalc on a TRS-80 Model I, that's how. He's now working on an online radio link to his Porsche to monitor fuel consumption in ZX81s/mile. . . Here's a thought, inspired by a recent trip to Personal Computers to see their latest product, an Apple-controlled video disk player — you could get all of Prestel's 180,000 pages onto just three video disks. . . Latest press release from the lovely Iona Uhl of Baroness (yes, she's a real Baroness) raves about the ABC series; pity the enclosed photo was of a SuperBrain, though. . . Our congratulations to 'H' of Lion House and Mrs H on the birth of a daughter, Davina Elizabeth.

Rumour has it that Davina sold three systems to the hospital staff before she got out of the delivery room. . . Talking of Personal Computers earlier reminds us to ask everyone to stop confusing that company with this magazine — despite the vaguely similar names, we're not connected and we're mutually tired of getting each other's mail, interesting reading though it sometimes makes (you can have the letter from 'Gloria of Bognor Regis' for £50, Mike). . . Now here's an interesting idea, courtesy of the luscious Susan Ben-David of SBD Software (now you know what the SBD stands for): computer-controlled joysticks to go with the latest American craze, soft-porn software. . . Will Messrs King, Radcliffe and Hulme please

write to us; yes, we've lost your addresses and we owe you money. . . 'I LIED' ADMITS EDITOR! Shock horror revelation: despite his claim to the contrary, Editor Tebbutt did actually achieve high resolution graphics on the VIC — see photo on page 89. In fact he got the hi-res running after the article was typeset but before the photos were taken. Incidentally, the picture on the screen is an impression of one 'Henry'. . . Congrats to Adrian Stokes on being appointed director of computing at St Thomas's hospital — now he won't have so far to go to clear up the aftermath of his frequent Malaysian excursions (we're talking about your *foot*, Adrian). . . Don't call your Othello program 'Othello'. We're advised that somebody has registered it as a trade

mark so can we have suggestions for an alternative name. . . Hilarious tales reach us of Robin 'Bogey' Bradbeer's antics while on a press trip to Nice. We weren't invited (sulk) so we can't provide a first-hand report of the now notorious Missing Underpants Incident. . . 'Informed sources' tell us that there'll be a lot of Tandy Color Computers around this Christmas, not all of them being sold with Tandy's name on them. . . Last-minute addition to all the fantastic things happening at the show: by popular demand, 'Bumper' Harris and 'Legless' will repeat their demonstration of traditional Sioux dancing atop Hammersmith Flyover just after the show closes on Saturday. Donations to pay for the pre-dance bar bill will be gratefully received.

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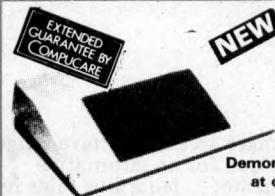
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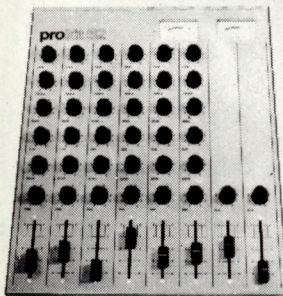
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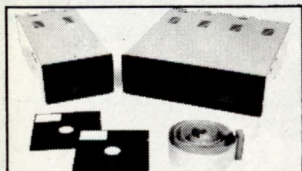
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